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ABSTRACT

Energy activities and lesson plans for grades 11 and 12 (grouped into seven units representing seven major conceptual schemes) are provided in this teachers' guide, with a unit at each grade level for each conceptual scheme. Conceptual schemes addressed include: (1) energy is the ability to do work; (2) energy comes from the sun; (3) energy can be changed from one form to another; (4) the sun is the earth's chief source of radiant energy; (5) people use energy to satisfy their needs; (6) energy supplies are limited; and (7) living things are interdependent with one another and with their environment. Each unit includes a pre-/post-test evaluation instrument, lesson plans, and supplemental activities. Lesson plans consist of a specific energy concept, objective, and instructional strategies for introducing, developing, and extending the lesson. Purpose, materials, and procedures are provided for each of the supplemental student activities. The guide begins with a brief introduction to teachers and statement of the energy policy for Florida and concludes with a list of key vocabulary words (Enerwords), bibliography, sources of energy information and teaching materials, and an evaluation sheet. (JN)

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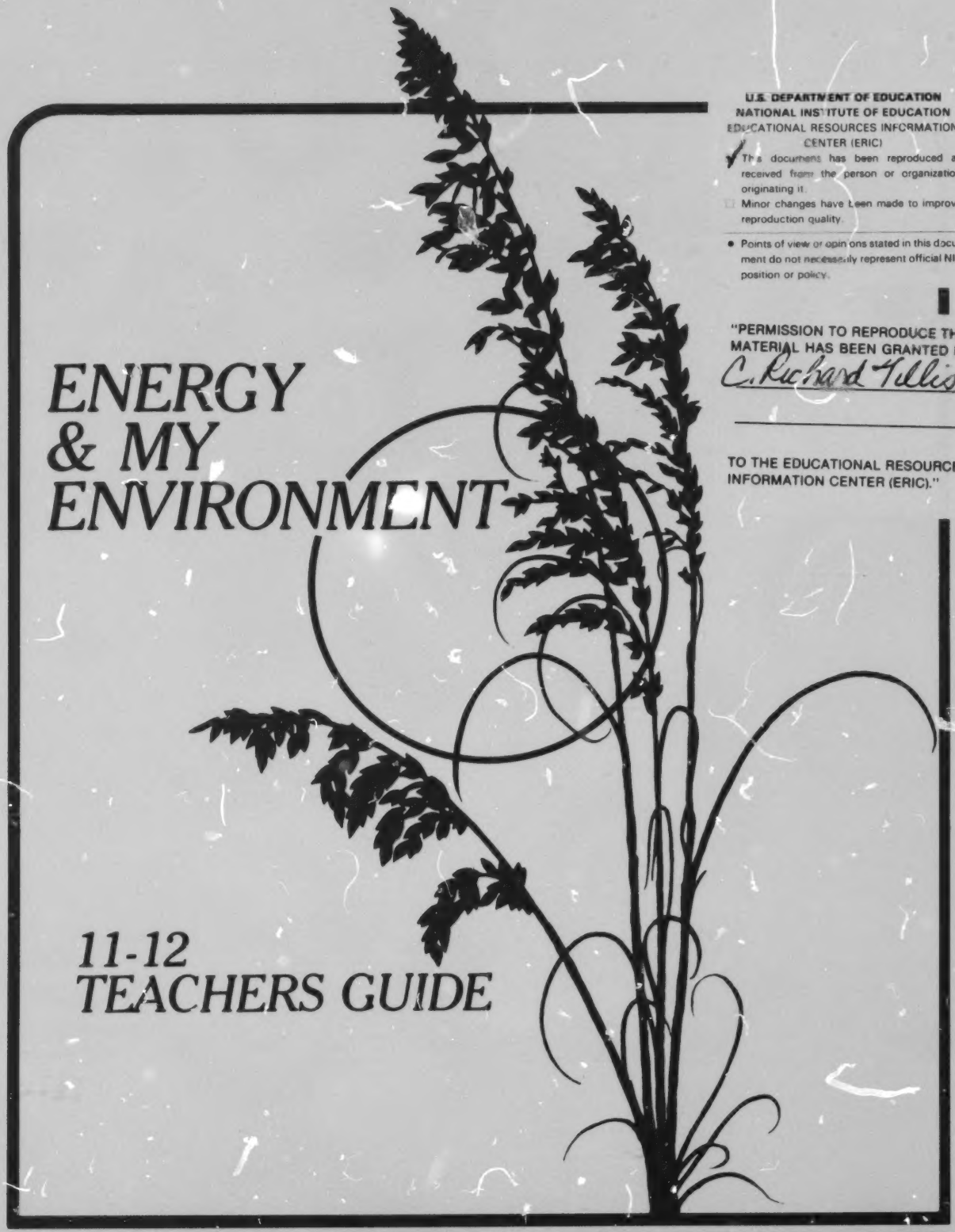
ENERGY & MY ENVIRONMENT



11-12 TEACHERS GUIDE

SE 038 818

Governor's Energy Office / State of Florida
SAVE IT, FLORIDA.

ENERGY AND MY ENVIRONMENT

TEACHERS' GUIDE

FOR

GRADE ELEVEN AND GRADE TWELVE

Written by:
Matthew J. Brennan, Ph.D.

Series Editors:

Rosalyn B. Tillis
C. Richard Tillis

June 1982

Governor's Energy Office
State of Florida

We are all parts of a great Web of Life - -
Powered by the Sun - -
All interdependent with the others.....

John H. Storer
1938

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FOREWORD

This Grade Eleven through Grade Twelve teachers' guide is the fifth of a series entitled ENERGY AND MY ENVIRONMENT. Other volumes of this series are:

ENERGY AND MY ENVIRONMENT, K - 3 Teachers Guide
ENERGY AND MY ENVIRONMENT, 4 - 6 Teachers Guide
ENERGY AND MY ENVIRONMENT, 6 - 8 Teachers Guide
ENERGY AND MY ENVIRONMENT, 9 - 10 Teachers Guide

After participating in many curriculum development and educational planning projects, the editors recognized one element that permeates those which were most successful. That element is the establishment of major ideas which serve as recurring themes throughout the child's educational experiences. This publication is designed to integrate key energy and energy conservation ideas in just such a manner.

The State of Florida was most fortunate indeed in obtaining the services of Dr. Matthew J. Brennan as the author of this series of teachers' guides. His work as editor on the PEOPLE AND THEIR ENVIRONMENT series established him as one of the founders and principal practitioners of this cognitive theme approach.

Through the Tri-County Teacher Education Center, Sebring, Florida, teachers were employed to select supplemental activities to accompany the lessons prepared by Dr. Brennan. Funds for this activity were provided through the mini-grant program of the Office of Energy and Environmental Education, Florida Department of Education.

These materials are designed to provide the flexibility that any good teacher demands, yet provide the recurring themes which may well be essential if the lessons are to have any lasting impact on the student. These materials can play an important role in the development of a citizenry that thinks and acts on a basis of factual knowledge of key energy concepts and also possesses an understanding of the great national and international web of energy relationships and interdependencies important for the citizen of today and essential for the citizens of the future.

The editors wish to thank the dedicated educators who have contributed their time and expertise to make this series, ENERGY AND MY ENVIRONMENT, available to the teachers in Florida's schools. A special thank you goes to secretaries Edie Boynton and Patricia Patrick for the long hours spent preparing these manuscripts for printing, and to Mary Lou Stursa and Dr. Rodney Allen for their expert assistance.

The Editors

INTRODUCTION - TO THE TEACHER

Is there an "energy crisis"? There has always been an energy crisis, as humans struggled to survive on planet earth. Now we face a new energy crisis - a crisis related to the future supply of the fossil fuels on which our civilization depends. This new energy crisis provides unlimited possibilities for student activities that will help children learn about the earth, how the use of energy has shaped civilizations of the past and present, and how it will determine the civilizations of the future.

Through their use of energy, humans have radically changed the environment. Now we must face the consequences of these changes, not only on the environment, but on all of life, including our own; on our societies; on our economies; on the air we breathe and the water we drink; on the lifestyles we lead; on the quality of the environment; and on the lives of the animals with whom we share the earth. The changes were made by people. The problems they have created can be solved only by people - indeed, by people who wish to solve them.

So we have reached the "crisis." The fossil fuels, which gave us unlimited supplies of cheap energy, are being depleted rapidly. The time for decision has arrived. How will we answer? We have the technology to solve most of the energy-related problems of the earth environment. Whether we solve these problems will depend on how clearly they are recognized and whether our values will demand their solution. It is hoped that the activities in this guide will help students understand the scientific, social, and aesthetic alternatives that must be considered.

The activities have been organized around the seven major conceptual schemes relating to energy, with a unit at each grade level for each one of the conceptual schemes. In addition, there is a lesson concept for each lesson and supplemental activities to help the teacher coordinate the activities with other areas of the curriculum. Each lesson is designed to suggest some activity, with the emphasis on "suggest," because students and teachers will be free to interpret each activity as they will.

You will have many ideas for variation and improvement of the lessons and supplemental activities.

PLEASE RETURN THE REVIEW SHEETS LOCATED IN THE BACK OF THIS BOOK. IT IS NECESSARY THAT WE HAVE INFORMATION FROM YOU FOR EVALUATION PURPOSES.

ENERGY POLICY FOR FLORIDA

WHEREAS, energy availability strongly impacts upon every aspect of human existence and the conservation of energy resources is essential to the health, safety, and welfare of the people of this state and to the well-being of the state economy, and

WHEREAS, Florida is particularly dependent upon other states and nations to supply its energy needs, and

WHEREAS, the majority of Florida's energy requirements are obtained from petroleum and natural gas, and the supply of these fuels is subject to interruption, and

WHEREAS, wasteful, inefficient, uneconomic, and unnecessary use of energy will result in a serious depletion of energy resources and represents a potential threat to preserving the health, safety, and welfare of the people of Florida, and

WHEREAS, alternative sources of energy are years from being fully developed and there is a pressing need to accelerate research and development of these sources, and

WHEREAS, energy conservation represents a meaningful, immediate, and appropriate state response to the energy problem by eliminating waste and inefficiency and increasing economic productivity, by reducing the depletion of our domestic energy resources which, in turn, increases economic flexibility of the people of Florida, and by decreasing the pressure to develop marginally efficient methods of energy production and thereby reducing the flow of capital from the non-energy sections of the economy and avoiding serious impacts on our environment, NOW, THEREFORE, BE IT RESOLVED

IT SHALL BE THE POLICY OF THE STATE OF FLORIDA TO:

1. Develop and promote the effective use of energy in the state and discourage all forms of energy waste.

2. Play a leading role in developing and instituting energy management programs aimed at promoting energy conservation.

3. Include energy considerations in all planning.

4. Utilize and manage effectively energy resources used within state agencies.

5. Encourage local governments to include energy considerations in all planning and to support their work in promoting energy management programs.

6. Include the full participation of citizens in the development and implementation of energy programs.

7. Consider in its decisions the energy needs of each economic sector, including residential, industrial, commercial, agricultural and governmental uses.

8. Promote energy education and the public dissemination of information on energy and its environmental, economic and social impact.

9. Encourage the research, development, demonstration, and application of alternative energy resources, particularly renewable energy resources.

10. Consider in its decision making the social, economic and environmental impacts of energy-related activities, so that detrimental effects of these activities are understood and minimized.

11. Develop and maintain energy emergency preparedness plans to minimize the effects within Florida of an energy shortage.

(Chapter 377.601, Florida Statutes)

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Title: Supply Costs

Concept: It takes energy to get energy.

Objective: To understand the reasons for the increasing costs of energy

Introducing the lesson:

1. Ask: Why does gasoline cost so much?
2. Discuss the Gulf Oil Corporation brochure (at end of this lesson) on this question.

Developing the lesson:

1. Investigate the 1980 law to tax "excess profits" of oil companies. (get a copy from your Congressman)
2. How can you explain a law to tax "excess profits" when Gulf Oil and other energy companies say they are only making a small profit?
3. Investigate why unleaded gasoline costs more than regular. (It is made from a higher grade "light" crude oil, which contains more of the hydrocarbons needed to make higher octane fuel; it requires additional refining - catalytic "cracking," plus purification; and it requires other chemicals to boost octane ratings to the level supplied by lead added to the gasoline.)
4. Why does the search for oil supplies cost more each day? (The remaining supplies are deeper, farther away, in very harsh environments, or available only by enhanced recovery.)
5. Discuss other rising costs of energy supplies. (transportation, research, production, marketing, and environmental controls)
6. Survey the class to see if everyone agrees with the conclusion on Gulf's brochure. What are the alternatives?

Extending the lesson:

1. Investigate the costs of pollution control in automobiles, electric power plants, factories.
2. Investigate the hidden "costs" of pollution. (health, water purification systems, aesthetics)
3. Who is responsible for rising energy costs? (OPEC prices, scarcity brought on by waste and excessive use, depleted oil resources, everyone who uses energy)

4. Discuss possible future costs for energy supplies.

5. Design a chart or picture which shows what energy costs might be in 2000 A.D.

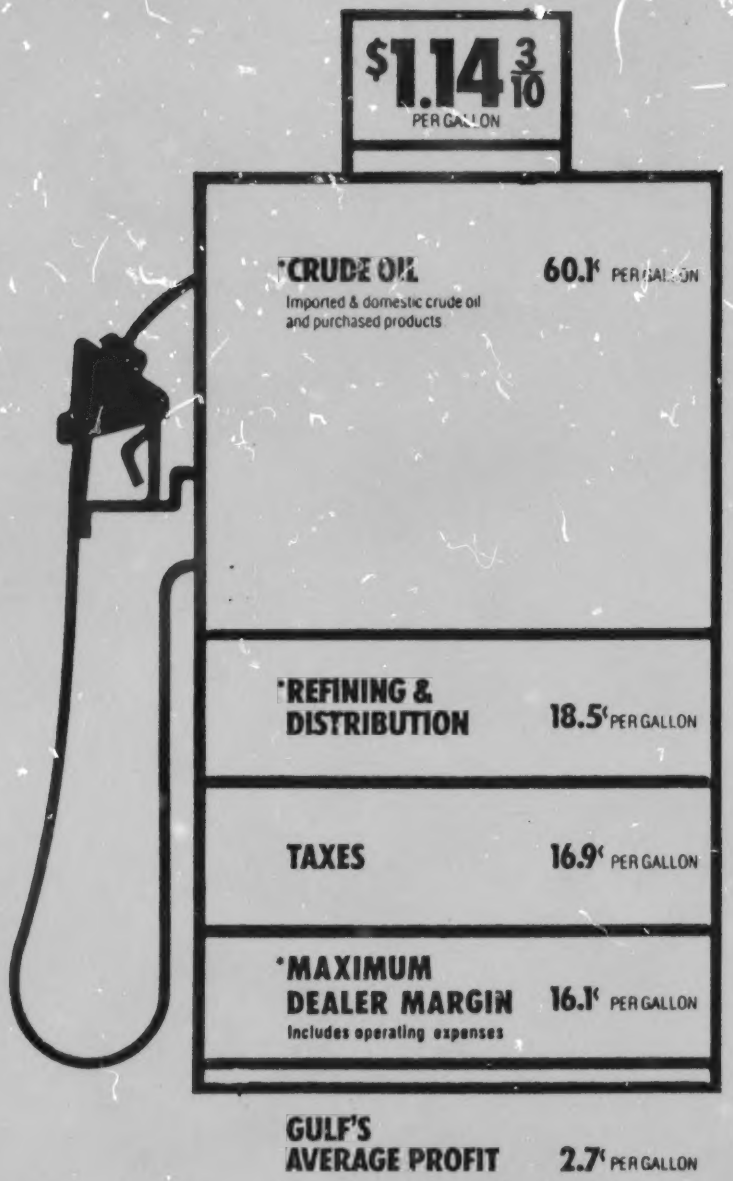
6. Check the validity of the statement: It takes fuel to get fuel.

7. Discuss the pros and cons of developing deepwater ports off the coast of Florida so that the supertankers could bring oil directly to the state for refining. (This would also mean building a refinery or refineries along the coast of Florida.)

8. Survey class reaction to a refinery in your community.

9. Study a map of Florida to determine if and where it is feasible to build a refinery or refineries.

10. Discuss the feasibility of building a refinery in your area.



Price is the dealer's retail price of Good Gulf (leaded regular) gasoline in the Pittsburgh, Pa. district, as of December 1979.

*Breakdown is based on Gulf's interpretation of the Department of Energy's regulations concerning pricing of products and allocation of costs.

Costs of distribution depend on distance from the refinery and other factors, so they vary from place to place.

Includes federal income and excise taxes and Pennsylvania excise taxes, which may be different in other states.

The Department of Energy sets an upper limit to the independent service station operator's gross margin, which covers wages, utilities, rent, etc., as well as his profit. Some dealers take less than the 16.1¢ currently allowed for operating expenses and profits.

Average profit per gallon on all refined petroleum products and natural gas equivalents sold in the U.S. in 1979.

As you can see, the biggest part of the price you pay for gasoline is in the price of crude oil. Since 1973, the cost of imported crude to the American oil industry has gone up about 700%. And about half of Gulf's supply is imported oil.

Gulf's profits from its operations around the world, in addition to its sales of petroleum products in the U.S., totalled $1.32 billion in 1979. These profits, supplemented by cash from other sources, provide funds for Gulf's capital expenditures programs, which in 1979 totalled $2.5 billion. In 1980 we plan to spend a total of $3 billion for energy-related projects.

This money is used in three major areas. First, exploration for and development of new oil and gas supplies. Second, improvement of our refineries to increase their ability to produce high-quality gasoline and home heating oil. Third, development of alternative energy sources such as shale oil, tar sands, coal gasification and coal liquefaction.

Only a small part of the price of gasoline is Gulf's profit. Misunderstood though they are, such profits are the surest means of helping to develop new energy supplies and to reduce America's dependence on imported oil. Only by increasing domestic production and by using energy more efficiently is there any reasonable expectation of even beginning to slow down the spiraling price of gasoline.

Gulf

GULF OIL CORPORATION

Title: Energy Use in Florida

Concept: Energy is the ability to do work.

Objective: To understand how energy is used in Florida

Introducing the lesson:

1. Have students examine Florida Energy Profiles (at end of this lesson)
2. Are there any significant differences between Florida and United States consumption? (yes)

Developing the lesson:

1. Determine the percentage of petroleum fuel consumed for the generation of electricity. (nearly 50 percent)
2. What is the most commonly used fuel? (petroleum)
3. What are the principal uses of natural gas? (electric power generation - 44.6 percent in 1976; manufacturing; and residential)
4. Discuss the present and possible future uses of coal as a fuel for electric power generation in Florida. (not now important but will be used increasingly as oil supplies diminish in the future)
5. Investigate the proposals to construct a coal slurry pipeline from Appalachia to Florida. (Contact Continental Resources, Orlando, Florida for information)
6. Discuss the residential uses of energy in Florida as shown in Florida Energy Profiles.
7. Why do residential energy conservation proposals concentrate on air conditioning and water heating? (These two uses of energy account for 57 percent of residential use in Florida.)
8. Contact the Governor's Energy Office in Tallahassee for recent data.
9. Compare recent data with 1978 data.

Extending the lesson:

1. Discuss the pros and cons of a coal slurry pipeline to supply coal for electric power generation in Florida. (Consider the water supply and waste-water disposal in Florida. Would the waste water be similar to acid mine waste-water in Appalachia?)
2. Compare and contrast the uses of energy in the commercial and industrial sectors.

3. Discuss the use of energy for transportation.

4. Devise a conservation plan to reduce energy use for:

   a. transportation.

   b. air conditioning.

   c. your school.

5. Implement your plan.

6. Discuss the future for railroads in Florida. (Consider how coal may be brought to Florida if the coal slurry pipeline is not built.)

7. Discuss transportation for tourists and agricultural products to Florida.

8. Study and discuss the chart, "Trends Contributing to Florida's Electric Energy Consumption." Are the 1972 projections valid today?

   In 1972:

   a. population was rising rapidly.

   b. personal income was rising rapidly.

9. For tourism data, check the monthly motor gasoline consumption (available from the Governor's Energy Office, Tallahassee) and compare the tourist season use with other months.

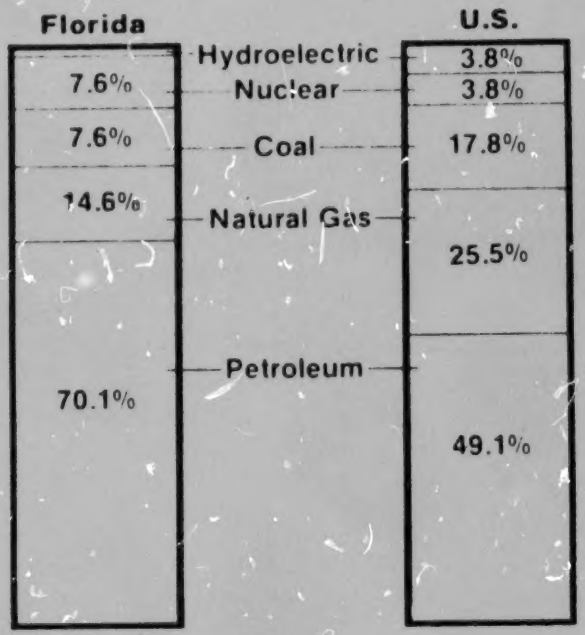
10. Discuss why a state which relies on gasoline to move its products and people is vulnerable to energy scarcity.

FLORIDA ENERGY PROFILES

Florida is unique among the states in regard to energy.

• In 1978, the state depended on petroleum and natural gas for almost 85 percent of its energy needs. petroleum constituted 70.1 percent of the total consumption of primary energy. This contrasted with the United States as a whole, which used petroleum and natural gas for approximately 70 percent of its energy needs, with less than 50 percent of primary energy consumption being petroleum.

Percentage of Total Energy Consumption By Primary Energy Source
Florida and the U.S., 1978

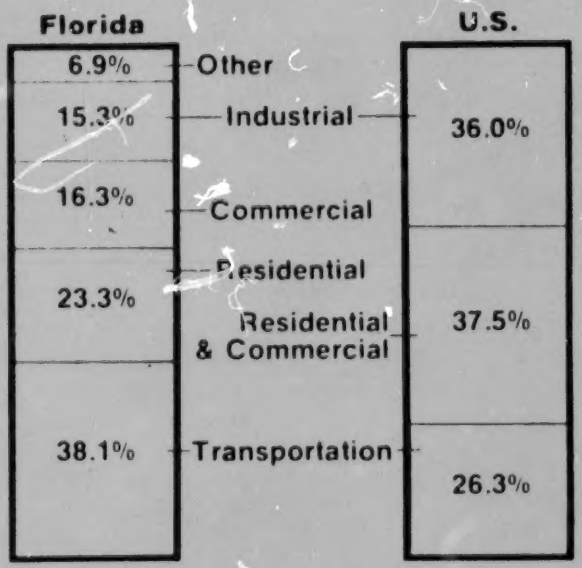


Total Consumption:

Florida	2,266.5 trillion BTU
U.S.	78,474.9 trillion BTU

• The consumption of energy in Florida differs from that of the country as a whole. The transportation sector is the largest energy consuming sector in the state. In 1978, transportation accounted for 38.1 percent of energy use in Florida, but only 26.3 percent of the nation's. While 36 percent of the country's total energy consumption was in the industrial sector, industry accounted for only 16 percent of energy use in Florida.

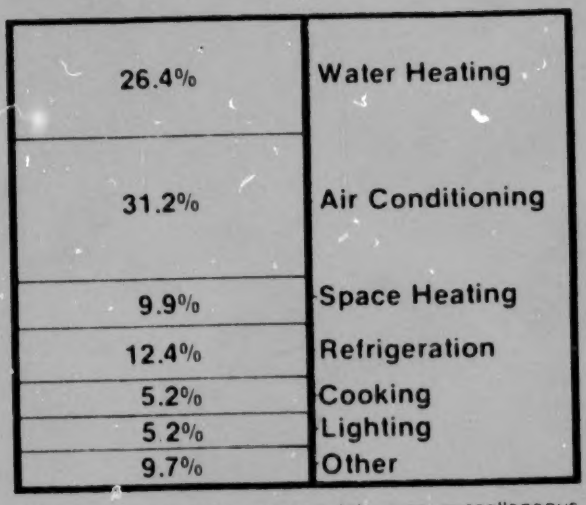
Percentage of Total Energy Consumption By Sector
Florida and the U.S., 1978



• Air conditioning and water heating are the top energy consumers in Florida homes; these uses consume a much higher percentage of total residential energy than in other states. Conversely, heating of Florida homes uses far less energy than the national average for heating.

Residential End Uses of Energy In Florida
(Percentages of Total Residential Consumption)

Total Residential Energy Consumption:
1978 ..... 523.2 trillion BTU

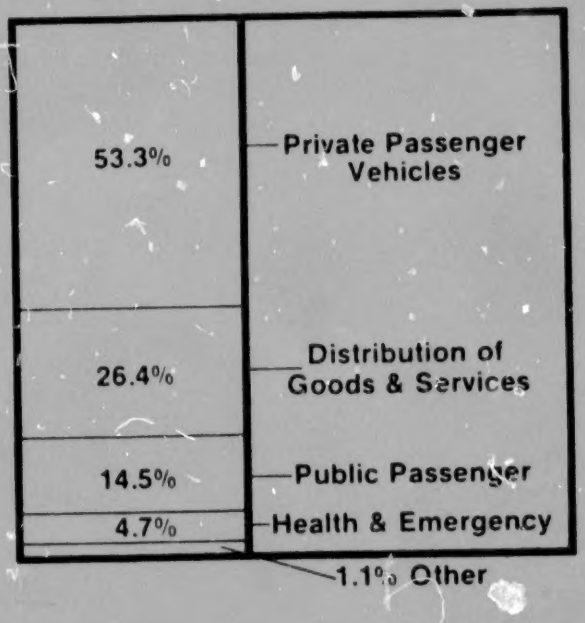


*Other includes clothes drying, television, miscellaneous

• More than half of all energy consumed for transportation in Florida fuels private passenger vehicles. Slightly over one-fourth of transportation energy consumption is devoted to distribution of goods and services (primarily via truck and rail). The bulk of public passenger transport in Florida is airline traffic; buses account for less than one percent of petroleum use in the transportation sector.

Transportation End Uses of Energy In Florida
(Percentages of Total Transportation Consumption)

Total Transportation Energy Consumption
1978 ..... 854.6 trillion BTU



• Primarily because there is relatively little heavy industry in Florida, the state's per capita energy consumption is lower than in the country as a whole. Since 1960, however, Floridians have increased their use of energy at a faster rate than the national average.

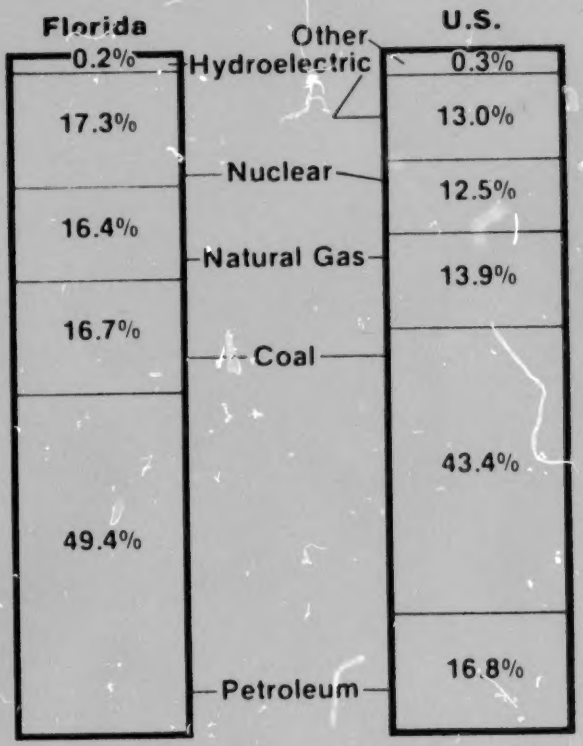
Primary Energy Consumption Per Capita
Florida and U.S., 1960 - 1978

	Per Capita Energy Consumption (million BTU)		Percentage Increase, 1960-1978	Relative Growth Rate, 1960-78
	1960	1978		
Florida	144.8	250.3	72.9	1.7
U.S.	242.0	358.5	48.1	1.4

Electricity

• A comparison of net electric generation by fuel type shows that 49.4 percent of electricity used in Florida is generated from petroleum, only 16.8 percent of the electricity for the country as a whole is generated from this fuel

Percentage of Net Electric Generation By Fuel Type
Florida and the U.S., 1978

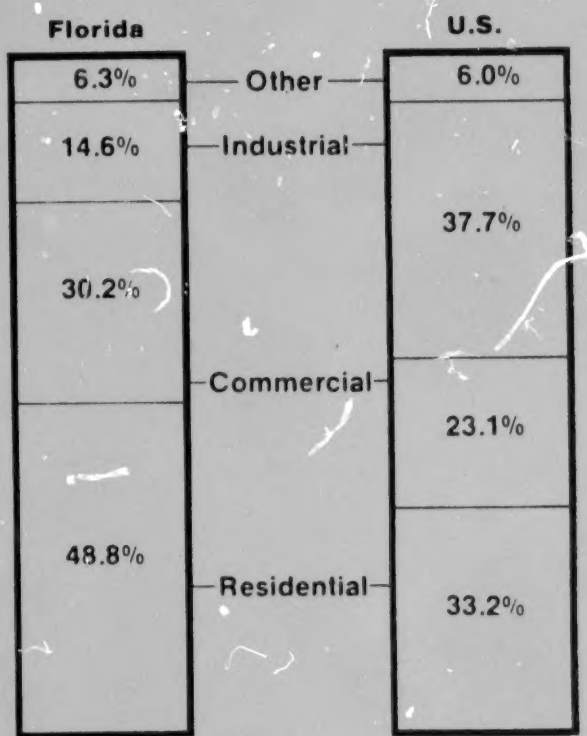


Total Electric Generation Fuel Consumption:

Florida	980.1 trillion BTU
U.S.	23,724.0 trillion BTU

• Statistics on sales to customers by class of service demonstrate that almost 48.8 percent of the electricity sold in Florida is for residential use, compared to a national average of 33.2 percent.

Percentage of Sales of Electricity To Ultimate Customers By Class of Service
Florida and the U.S., 1977



FLORIDA'S ECONOMIC BASE DEPENDS HEAVILY ON TOURISM, AGRICULTIRE, AND CONSTRUCTION - ALL HIGHLY ENERGY-SENSITIVE ACTIVITIES...

TOURISM

- Over 32 million tourists visited the state in 1978; over 22 million came by private passenger vehicle.
- In 1978; tourists spent over $12 billion in Florida; the sales tax collected from tourism amounted to almost $608 million. This represented approximately 33 percent of the total sales tax collected.
- Over 12 percent of the state's civilian labor force works in jobs directly related to tourism; many other jobs are indirectly associated with this activity.
- Estimates indicate that tourism accounts for approximately 12 percent of total energy consumption in the state, with 32 percent of total transportation energy consumption credited to tourism.

AGRICULTURE

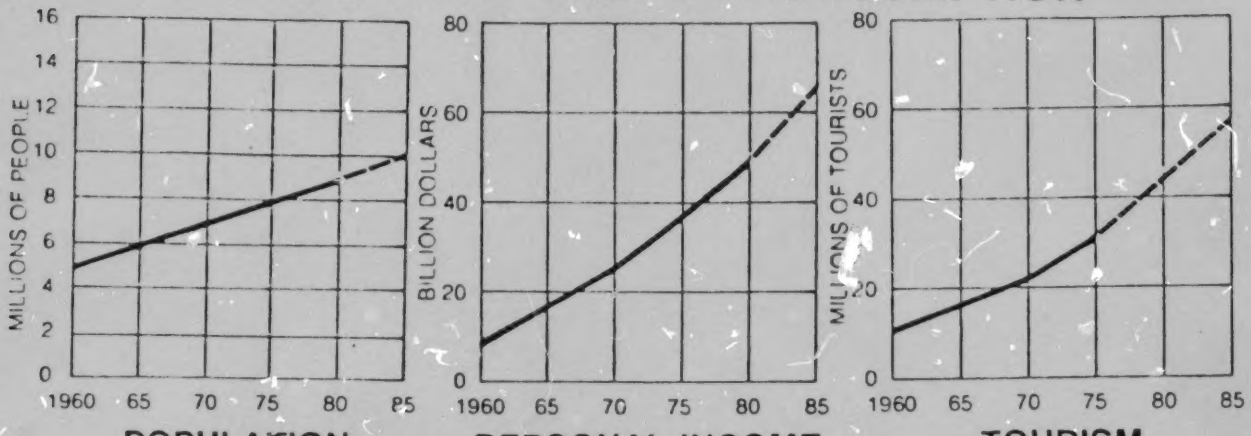
- In 1977, the estimated retail value of Florida's agricultural products was $7,786,780,000.
- Approximately 7 percent of the state's civilian labor force works in agricultural or agriculturally related jobs (e.g., food processing).
- Florida's agricultural system is energy intensive; more gasoline, diesel fuel, oil and LPG gas per acre is used for Florica agricultural production than in almost any other state. Florida is the third largest consumer of fertilizer (on a BTU per acre basis) in the nation; fifth in the use of insecticides, and third in the use of fungicides.

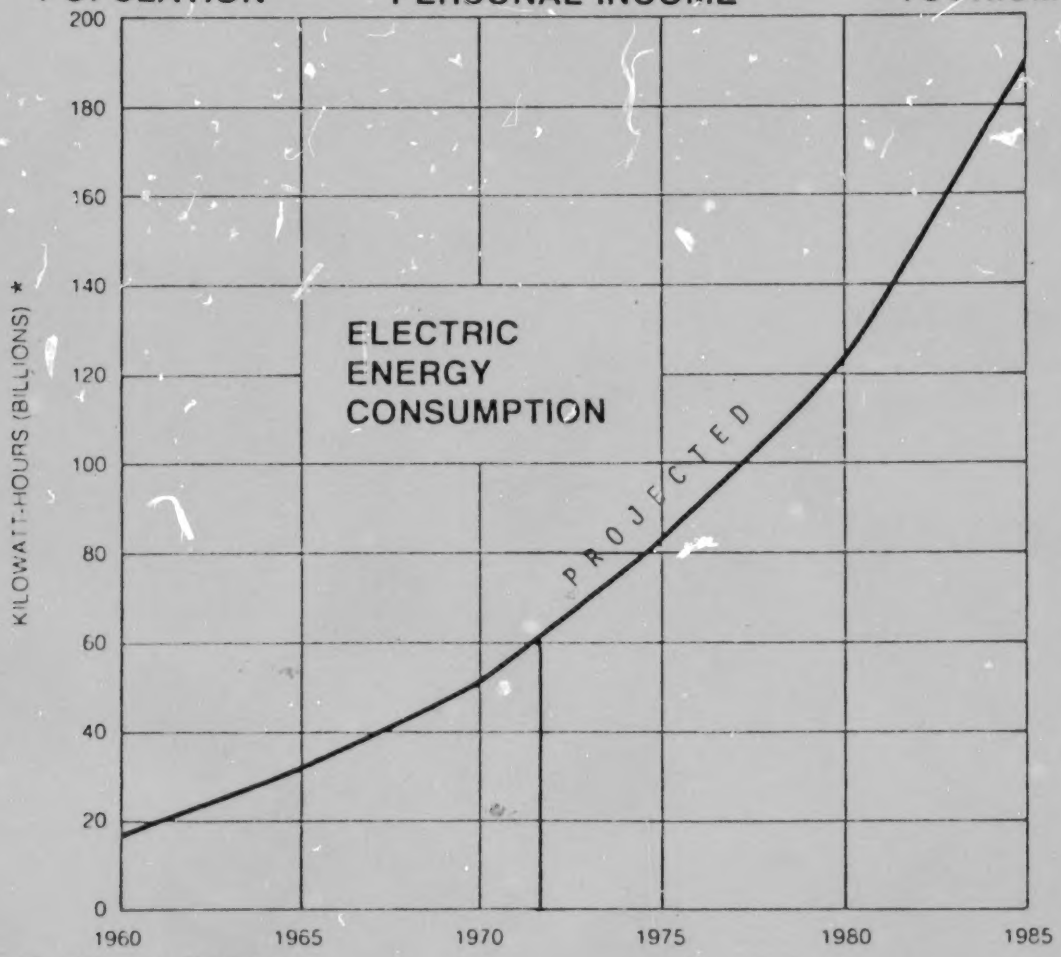
CONSTRUCTION

- In 1978, the value of building permits in Florida amounted to approximately $7 billion.
- Approximately 5.6% of the state's civilian labor force works in the construction industry.
- Florida produces very few of the building materials needed for construction; most must be transported from other states.
- Estimates indicate that construction accounts for slightly over 5 percent of the state's total energy consumption.

Information provided by: Florida Patterns Study Group, College of Business, Florida State University, and The Institute of Food and Agricultural Sciences, University of Florida.

TRENDS contributing to FLORIDA'S ELECTRIC ENERGY CONSUMPTION





*1 KWH = 3,413 BTU's

Sources: Bureau of Census Records; unpublished projections from the Bureau of Economic and Business Research, University of Florida; Report from the Department of Environmental Engineering, University of Florida; and Florida Trend Magazine, April 1972.

Title: New Fossil Fuels

Concept: Energy is the ability to do work.

Objective: To understand the relationship between fossil fuel formation and energy supplies

Introducing the lesson:

1. Show the class some fossils and review how fossils are formed from the remnants of ancient living things.

2. What are fossil fuels? (Not all organisms buried in the earth ages ago turned to stone; plant life often did not, and these plant remains form the basis of much of the earth's fossil fuels.)

Developing the lesson:

1. Review the formation of peat, lignite, and coal.

2. Investigate the formation of petroleum. (Probably the product of the accumulated fatty matter in the bodies of plankton in ancient oceans, which were buried in the sediments in which they are now found. Petroleum, being lighter than water, tends to ooze upward through the rock material which covers it, in some places reaching the surface as tars or bitumen. If the petroleum is covered by non-porous rock, it remains there until drills make a hole in the rock and the oil can be pumped out.)

3. Investigate places on earth where petroleum has reached the surface. (tar sands in Canada; the LaBrea tar pits in California)

4. Study the chart which shows the process of extracting oil from the tar sands in Canada.

5. Why is oil produced this way called "synthetic"? (because it must be processed before it becomes oil that can be used in a refinery)

6. Investigate formation and potential production of shale oil from oil shale. (Oil shale contains kerogen which, like the tar sands, can be processed to make crude oil.)

7. How much oil is available from tar sands and oil shale? (It is estimated that both sources of synthetic crude oil have the potential to produce more than the entire reserves of the Middle East. Getting it all out will be another matter, for the costs in terms of both the environment and dollars may be prohibitive.)

Extending the lesson:

1. Read about the "Suncrude" government-industry consortium formed to produce the crude oil from the bitumen tar sands in Northern Alberta, Canada.

2. Read about the museum in LaBrea, California, which was built to exhibit the Ice Age creatures which were preserved when they were trapped in the tar pits there.

3. Research the historical uses of petroleum.

   a. Zoroastrians built their altars near burning gas wells on the Caspian Sea.

   b. "Greek Fire," a fearsome weapon of the Bronze Age, was petroleum skimmed from Middle East waters.

   c. Noah is supposed to have caulked the seams of the Ark with tar.

   d. Job owned a rock which "poured me out rivers of oil."

   e. Tar was used as mortar in the Tower of Babel.

   f. American Indians used petroleum as paint, cosmetics, tonic, bath oil, glue, fuel, mortar, insecticide.

   g. English explorer George Vancouver described the Santa Barbara Channel in California in 1793: "As far as the eye can see, the sea is covered with a black sticky, smelly substance." It still is.

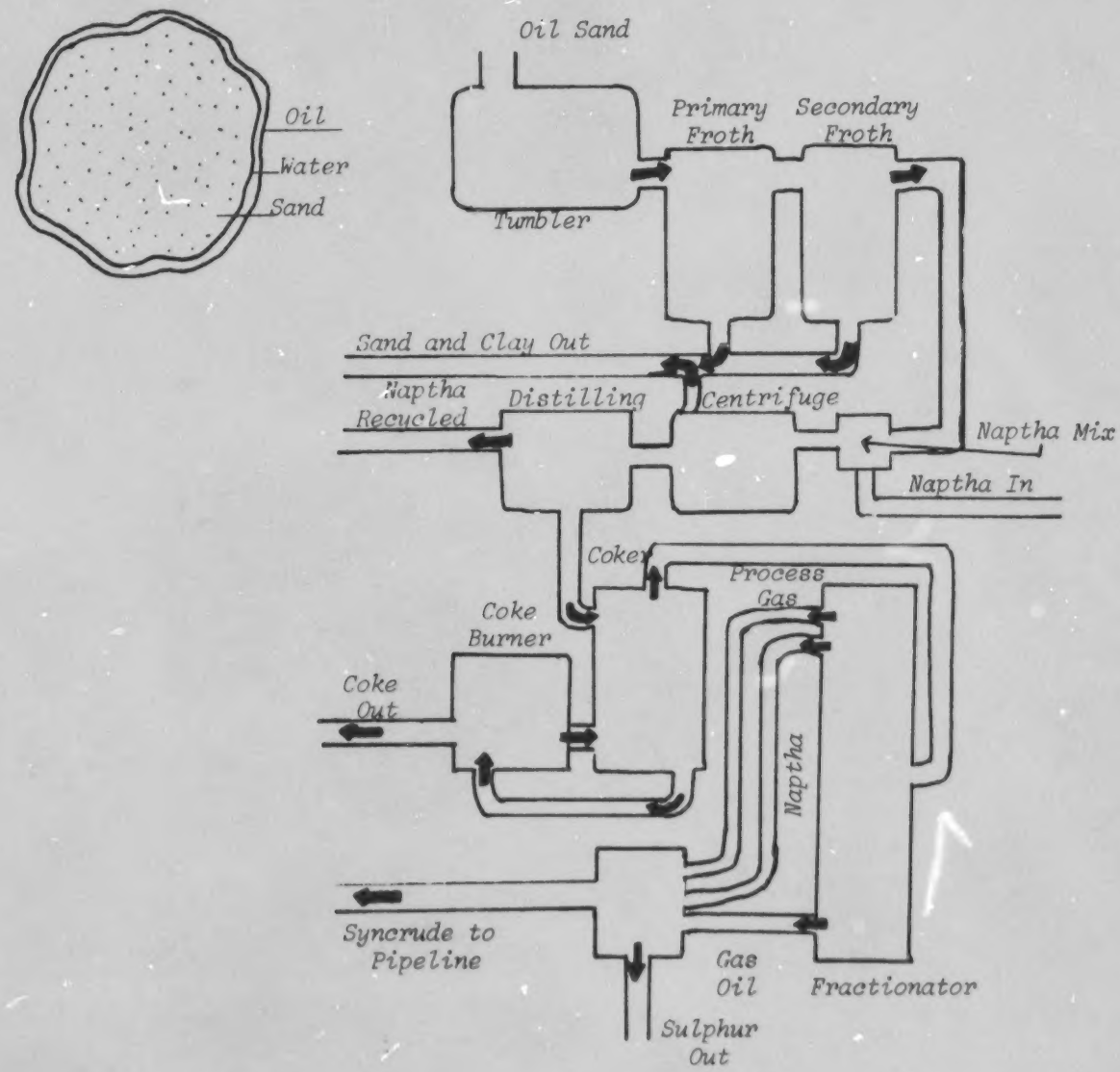
4. Investigate the environmental problems of various shale oil production technologies. Consider water needs, residues, and land reclamation.

5. Look at the chart "Fossil Fuel--Who Has It--Who Uses It," and discuss its implications for the future.

6. Design an oil lamp.

SANDS IN, OIL OUT

Deposits of sand near Canada's Athabasca River, each grain surrounded by a film of water and oil, provide the raw material for the syncrude project. Sands from the mining areas are tumbled with hot water and centrifuged with naphtha to remove solids. The heavy oil-like material which is left is then upgraded by coking, fractionating and desulfurizing to produce oil which can be run in a refinery. Syncrude began operation in 1978 with production reaching 50,000 barrels a day.



WHO HAS IT...

FOSSIL FUEL

WHO USES IT...

UNITED STATES ... 20%
Well endowed, the U.S. has roughly one-fifth the world supply of each fossil fuel.

...32%
U.S. uses more energy than it produces and imports much gas, oil.

MID-EAST 3%
This figure would be higher but African Arabic-speaking countries are not included.

...1%
Largely unindustrialized except for oilfields, Mid-east uses little of its production.

AFRICA 5%
Africa has modest amount of all three fossil fuels; most deposits are untapped.

...2%
Most emerging nations in Africa are energy-short, as fossil wealth lies unused.

EUROPE 6%
Europe also has vast deposits of all three minerals, it is converting them to energy.

...26%
Industrial appetite consumes fuel supply and Europe imports much oil.

RUSSIA & CHINA .. 52%
They have 62% of the world's coal; 30% of its oil; and 26% of its natural gas.

...22%
With the supreme supply of fossil fuel, Russia is planning to trade it for goods.

SOUTH AMERICA .. 2%
Over 60% of South America's small fossil fuel supply is oil, very little coal or gas.

...7%
Intensifying technology large population force South America to buy energy.

REST OF ASIA.... 12%
Asia's prime energy source is vast deposits of coal, 10% of the world's supply.

...10%
With too many people, Asia's fossil fuel supply limits standard of living.

Title: The Farmer As An Energy Producer

Concept: Energy comes in many forms.

Objective: To understand the energy requirements of food production

Introducing the lesson:

1. Write on the chalkboard: Americans are eating and drinking much of our fossil fuel reserves.

2. Ask the students if this is a valid statement.

Developing the lesson:

1. Investigate the use of fuels for food production. (Coal, oil, natural gas, and uranium are all used: to grow, process, transport, wholesale, retail, refrigerate, and cook food.)

2. Discuss the implications of the fact that the energy in the food we grow is less than one-sixth of the energy required to produce and deliver that food to you.

3. Ask: How long can our nation continue to produce food that is worth less than the energy needed to produce it?

4. Investigate the use of energy for growing food. (It is more than 2 percent of the total energy budget; half of this is used directly on farms for operating machinery, irrigating, heating, ventilating and crop conditioning; the other half is used to produce fertilizers, pesticides, feeds, and other farm supplies.)

5. Investigate the use of energy in the production of chickens. (Chickens are raised on assembly lines; packed cages mounted in buildings that are artificially heated, cooled, lighted, and ventilated; wastes are handled mechanically; feed is manufactured from a variety of ingredients, little of which is raised on the chicken farm.)

6. How much food energy does the average American consume each year? (About 1,500 pounds, with an energy content of 3,300 calories per day; unfortunately, a good part of the total is wasted and becomes garbage.)

7. Discuss the use of garbage for fuel.

Extending the lesson:

1. Investigate the use of energy for food processing. (75 percent of our food is processed before shipment; energy is used for boiling, steaming, freezing, drying, and cutting foods; for conveying and packaging the processed products.)

2. Trace the production of your favorite cake mix. (Ingredients are mechanically measured and conveyed to tanks, combined and mixed under controlled conditions; the mix then travels to machines that fill plastic bags - or cans; then filled bags are inserted into boxes, which are packed into cartons and transported to warehouses for shipment.)

3. What percentage of the nation's energy budget is used for food processing? (4 percent - double the amount for producing the food.)

4. Why is so much processing necessary? (More people are concentrated in cities, far from sources of food, so shipment of fresh, unprocessed foods would be impossible.)

5. In what ways to people consume energy in getting and keeping the food? How do people use the final energy for food? (They drive to the store, freeze or refrigerate the food, then cook it and refrigerate the leftovers.)

6. How much energy does the final consumer use? (One-third of the total food energy budget - about twice as much energy as it took to grow the food.)

7. Compare our food energy budget with that of primitive societies. (They do not use any fossil fuels to grow and distribute their food, and only a little wood to cook it.)

8. Try making a cake by measuring and mixing your own special ingredients. (Now you see why people want cake mixes.)

Title: Transportation 2000

Concept: Energy is used to move people and their products.

Objective: To understand the energy needs for transportation

Introducing the lesson:

1. Ask: How will Americans get where they are going in the year 2000? (After two years of study, the U.S. Transportation Policy Study Commission, under the chairmanship of Congressman Bud Shuster of Pennsylvania, answered the question this way: "Not much differently than they do today.")

2. Write to your Congressman for a copy of the Study Commission's report.

3. List the student responses to the question.

4. Find pictures of people and products moving in new ways, as, for example, the "people movers" at the Tampa airport and at Disney World.

Developing the lesson:

1. List the ways people and products move. (wheels, tracks, wings, and water)

2. Discuss where any changes in transportation will probably be. (Fuels - more diesel and synthetic gasoline, alcohol; and in rapidly rising costs.)

3. Commission Chairman Shuster warned that our transportation system may not meet future needs. Why was he so pessimistic? (Demand will increase rapidly, investment in transportation is lagging due to government over-regulation; money to keep up the nation's highways and railroads is not available.)

4. Discuss the four main themes in the report's more than 80 recommendations:

   a. less federal involvement.

   b. a uniform national policy. (Present policy favors some over others, for example, trucks over trains.)

   c. support by users of the systems - taxes, tolls, etc.

   d. an economic analysis of any proposed federal action before it can be put into effect.

5. What about fuels for transportation in 2000? (Still mainly from oil, although 20 percent of it may be synthetic.)

6. Investigate the problems of moving the increasing amounts of coal the nation will use. (Distances coal is moved will double; amount will triple - a sixfold increase in ton-miles, so the system of tracks and the supply of cars will be severely strained.)

7. How will people move? (Air, auto, train, and bus, as now; but air travel will increase drastically; automobile travel will be reduced.)

8. How will this affect fuel use? (Forecasts are for planes to use more oil than automobiles by 2000, although auto travel will still be four times greater than air travel in number of passenger miles.)

9. Investigate future use of water transport. (Is steadily increasing, mainly to move crude oil over long distances.)

10. What about pipelines, such as the proposed coal slurry pipeline to bring coal to Florida? (There are still many unresolved questions, such as water supply and what to do with the acid waste water at the end of the line in Florida.)

Extending the lesson:

1. Discuss alternatives to the second and third family car. (Rent a large car for special trips such as vacations, etc.)

2. Investigate reasons for the unpopularity of buses. (Buses run on schedules and usually take a longer time. People will still be in a hurry.)

3. Discuss what happened to the prediction of a return to the "good old days."

4. Design a Transportation 2000 billboard or TV advertisement.

5. Describe your community in the year 2000 in any way you wish.

6. Design a publicity campaign that will increase ridership on the public bus system.

Title: Nuclear Energy

Concept: Energy comes in many forms.

Objective: To understand the pros and cons of using nuclear energy for the production of electricity

Introducing the lesson:

1. Write on a chalkboard: Use of nuclear energy for power plants may save the world.

2. Write on another board: Use of nuclear energy for power plants may destroy the world.

Developing the lesson:

1. Ask the students to list the reasons why use of nuclear energy could save the world. Consider:

   a. availability of fuel. (At present rates and methods of use, the world has a 200 year supply; increased use would rapidly deplete the supply of fuel.)

   b. cost of fuel. (a little more than fossil fuels)

   c. air pollution. (none)

   d. safety record. (Despite several accidents, proponents of nuclear energy say there has never been any loss of life; neither have any lives been lost mining uranium, although miners may have been exposed to excessive radiation.)

   e. advantage over coal. (no strip mining or air pollution)

2. Now list the reasons why nuclear energy may destroy the world. Consider:

   a. danger of leak of radioactive liquid or gas.

   b. dangers of core meltdown.

   c. radioactive waste disposal. (There is no safe method yet; materials will remain radioactive for thousands of years.)

   d. environmental effects.

      1. mining - noise, dust, fumes, exposure to radioactive rocks

      2. reactors - leftover fuel storage; where? how?

      3. plutonium waste - easily converted into bombs

3. Investigate the effects of exposure to radiation. (Large doses can cause death; small doses cause leukemia, cancer, and genetic defects.)

4. What is the controversial "breeder" reactor? (It is a more sophisticated reactor which produces plutonium, which in turn can be used as a fuel; therefore, new fuels are produced in the reactor.)

5. Investigate the types of nuclear reactors.

   a. boiling water - steam at 212 degrees F. to run the turbogenerator.

   b. pressurized water reactor - liquids under pressure heated to 600 degrees F. in reactor core; these in turn heat low pressure water to produce steam.

   c. "breeder" reactor - core is liquid sodium, can be heated to 1150 degrees F., will produce steam at 1000 degrees F.; this would increase plant efficiency to 40 percent.

6. Investigate the status of nuclear power in Florida - past, present, projected, cancelled.

7. Investigate the "Three Mile Island" accident in Pennsylvania.

Extending the lesson:

1. What Florida government agencies have responsibility for nuclear power plant siting? (Department of Environmental Regulation; Public Service Commission; and Department of Community Affairs)

2. Investigate disposal of the nuclear plants themselves. (Plants have a life span of 30-40 years; then they must be "decommissioned." Current proposals call for burying the entire plant for 100 years, after which it would be dismantled by remote control and its parts buried; where? at what cost?)

3. Some critics say nuclear power is too expensive. Investigate relative cost of power plants and the cost of cleaning up after the "Three Mile Island" accident.

4. Discuss reasons why people are afraid of nuclear energy. (It is related in the minds of the public with the atomic bomb; it is unseen, and, therefore, feared.)

5. Design murals to illustrate the two sides of the nuclear power controversy.

6. Describe the murals.

7. What values made you decide on which mural to draw?

8. Would your decision be the same if nuclear energy was the only alternative to doing without your appliances?

9. Make a list of the appliances you would give up to avoid having a nuclear power plant in your backyard.

10. Investigate progress being made concerning fusion.

Title: Energy Transfer In Natural Systems

Concept: Energy can be changed from one form to another.

Objective: To help students understand the Second Law of Thermodynamics

Introducing the lesson:

1. Write on the chalkboard the following terms: forest, grassland, estuary, swamp, pond, coral reef, scrub.

2. Ask: What do all of these have in common? (All are ecosystems. Ecosystems are places where plants, animals, and the micro-organisms that process energy to maintain themselves all live. All have a plant community that produces food - the producers - using the energy of the sun; animals that use the food and recycle materials; and both plants and animals which use waste materials and recycle them.)

3. Write the Second Law of Thermodynamics on the chalkboard and discuss its meaning. (In all processes, some of the energy loses its ability to do work and is degraded in quality; used energy is dispersed as waste heat.)

4. Trace the flow of energy in the water cycle.

5. Trace the flow of energy in the earth ecosystem (biosphere). (Energy of the sun is captured in green plants; plant material serves as food for plant-eating animals; small animals are eaten by larger animals, with the original energy of the sun being passed along - minus the heat lost at each step; finally, decaying organisms return the materials of plant and animal bodies to the ecosystem for reuse.)

6. List the materials used in this energy transfer. (Carbon dioxide and oxygen from the air; water as rain, snow, or dew; nitrogen of the air; minerals from the soil; cycling of these elements driven by the energy of sunlight; each level stores energy and loses heat energy; the energy lost must be replaced by sunlight to keep the materials recycling.)

7. Trace the flow and loss of energy in a typical Florida food chain. (algae, snail, fish, larger fish, eagle, and bacteria)

8. What would happen if there was no heat (energy) loss at each step in the food chain? (Organisms would continue to grow every time they ate; warm-blooded animals would be cold.)

Extending the lesson:

1. Extend the discussion of energy transfer to people's inventions - cities, farms, industry, markets, etc.

2. Draw a mural depicting a Florida food web - in a pond, cypress, swamp, scrub, estuary, etc.

3. How do people make use of the Law of Entropy (another name for the Second Law of Thermodynamics)? (People need heat for some things, so they burn fuels to get heat to make steam or to heat their homes.)

4. Trace the flow of energy to keep an automobile running. (fuels, repair, roads, traffic signals, etc.)

5. Discuss a world without recycled materials. Nothing would decay; minerals would be tied up in bodies of plants and animals.

6. How do people's activities interrupt the normal cycles by:

   a. use of pesticides?

   b. monoculture or one-crop agriculture?

   c. overfishing or overhunting?

   d. land development?

   e. forest harvest?

   f. other activities?

Title: A Slice Of Toast

Concept: Energy can be changed from one form to another.

Objective: To help students understand the amounts of energy they use every day and where it comes from

Introducing the lesson:

1. Ask the students to list the forms of energy available to them within 100 feet of their present location.

2. Now make a list of the forms of energy available to them within 20 steps of their room at home. (heat, light, cooling, food, water, transportation, radio, TV, etc.)

Developing the lesson:

1. Trace the energy journey of our morning slice of toast before it arrives on the breakfast table. Consider: growing the grain, harvest, transportation to mill, making bread, transportation to store, marketing, selling, transportation to house, toasting, plus packaging at several steps along the way, and human energy. (Did you forget the energy to make the toaster, packaging, etc.?)

2. What is the common factor? (Energy is used at each step.)

3. Discuss why the word "manufacture" is the wrong word to describe the process of making things. (Manufacture means to make by hand; it is really a process of coalfacture, oilfacture, electrofacture, nukefacture, etc., because the energy used to make things comes from these sources.)

4. Discuss the validity of this statement: We have woven ourselves in a web of electric wires.

5. Discuss how much energy (electricity) we really need.

6. Look around you for an item that did not require energy in its manufacture. (There are none.)

7. Investigate efforts by supermarkets to reduce the amount of energy used. (for example, closed instead of open frozen food cabinets)

Extending the lesson:

1. Listen periodically during the class periods for the sound of engines and motors. (Ordinarily you would not notice them because they are so much a part of your environment.)

2. Ask: Have you ever had trouble sleeping on a camping trip because it was too quiet? (We are so used to the sounds of energy being used, we miss them when they are not present.)

3. Discuss the basic question about meeting our needs in a world of decreasing energy supply. How can we obtain enough energy to continue our basic way of life?

4. Discuss whether our basic way of life is very "basic."

5. Check on the student lists (compiled in Introducing the Lesson) to determine which items they could do without.

6. Is this a valid statement: We could change many of our energy-wasting habits without changing our lifestyles?

7. Draw a picture of modern-day campers without their portable appliances.

8. Compare camping in a tent while backpacking with camping in a motor home.

9. Obtain the movie "Toast" from your local utility company or from the Governor's Energy Office in Tallahassee. This is an excellent film to introduce or end this lesson.

Title: Energy And Food -- A Losing Proposition

Concept: Energy can be changed from one form to another.

Objective: To help students understand the fossil fuel energy costs of modern agriculture

Introducing the lesson:

1. Ask: Is it possible that we could use more energy to produce food in the United States than the food contains? (It is not only possible, it is happening.)

Developing the lesson:

1. Investigate the three ages of agriculture in terms of energy use:

   a. from Neolithic to early 1900's - total dependence on solar energy for human and animal labor, with wastes used for fertilizer.

   b. transition period from 1900 to 1950 - farm machinery available; solar energy supplemented with stored fossil fuel energy.

   c. present - past 30 years - fossil fuel energy for machines, synthetic fertilizers, pesticides, irrigation.

2. Investigate how modern agriculture is subsidized by fossil fuel energy. (We now use six times as much energy to produce food as the food contains.)

3. Discuss the validity of this statement: Agriculture today has shifted from soil to oil.

4. Agriculture could be an energy-producing segment of the American economy. Yet it is a major consumer of our stores of energy, using more petroleum than any other single industry. Discuss the significance of this situation as oil supplies dwindle.

5. Investigate the relationship between agriculture and population. (In the first age, agriculture determined population - and still does in underdeveloped countries; populations are now determined by the ability to use synthetic energy for agriculture; the balance is no longer natural.)

6. Investigate the role of energy in the development of "agribusiness," or large-scale farming. (Impossible without machinery, fertilizers, pesticides, irrigation.)

7. Investigate the role of the Tenneco Corporation, the nation's leading energy conglomerate, in agriculture. (It is now a leading agribusiness, as well as a leader in oil, coal, and uranium production; farms nearly 2 million acres; manufactures farm machinery and equipment, fertilizers, and pesticides; packages fruit and vegetables and ships them by jet freight - a total operation.)

8. How much fuel is used?* (The use of tractor fuel alone has surpassed the energy converstion of sunlight for a given unit of agricultural land; 5 million tractors use 8 billion gallons of fuel, the equivalent of the chemical energy of the food produced by American agriculture; all other fuel is used at a loss.)

Extending the lesson:

1. Investigate the environmental consequences of American synthetic agriculture. (pesticides, fertilizers, loss of wildlife habitat along farm borders, irrigation, pollution from burning fossil fuels)

2. Ask: Are there alternatives?

3. Discuss how long the United States can continue to import costly oil to subsidize production of food which we export at a loss.

4. Investigate the program of exporting high energy farm technology to underdeveloped countries -- called the "Green Revolution."

5. Compare the diets of Americans in 1940 and today. (Now, people eat more processed foods, instant foods, meats with lower protein and more calories.)

6. Make a similar investigation for the production of fiber.

7. Discuss this typical Florida supermarket purchase and its implications - onions or tomatoes grown in Mexico, packaged in California, shipped by air to Florida, and sold at a price below the price for local onions and tomatoes.

Title: "Sunshine"

Concept: The sun is the source of the earth's radiant energy.

Objective: To appreciate how the sun affects us

Introducing the lesson:

1. Listen to the John Denver record "Sunshine."
2. Discuss the message of the song.

Developing the lesson:

1. Discuss how the sun has affected our modern cultural environment.
2. Locate other examples of "sun" in our culture.
3. Locate examples of "sun" in other cultures.
4. Find products that use "sun" in their brand names.
5. Why is Florida called the "Sunshine State"?
6. Discuss your feelings about seeing a sunrise or sunset.

Extending the lesson:

1. Write another verse to the song "Sunshine."
2. Read poems to the sun in The Sun's Birthday by John Pearson (Doubleday and Company, Garden City, New York 11530, 1973).
3. Discuss the photographs of Dennis Stock in Brother Sun (Sierra Club, 1050 Mills Tower, San Francisco 94104).
4. Design a poster entitled "Sunshine."
5. Describe your feelings about the sun.
6. Investigate how primitive peoples explained the course of the sun each day. (for example, the ancient Greek god Apollo in his chariot driving across the sky)
7. Write to the Florida Solar Energy Center, 300 State Road 401, Cape Canaveral 32920 for information about Sun Day - May 3.

Title: Solar Cells

Concept: The sun is the source of the earth's radiant energy.

Objective: To understand the use of solar cells for producing electricity

Introducing the lesson:

1. Say: One of the most important inventions of all time took place in the Bell Telephone Laboratories in 1954, yet its use is generally not known by the public - the discovery of the photovoltaic method of producing electricity from the sun's radiant energy using silicon solar cells (photo-cells).

2. Demonstrate a simple solar cell apparatus.

Developing the lesson:

1. What is a silicon solar cell? (It is a thin wafer of electrically conductive material that generates direct current electricity when exposed to solar radiation.)

2. How do solar cells work? (Silicon strips - wafers - are cut from large crystals, coated with boron or other material to produce a positive electric layer which interacts with the underlying negatively charged silicon layer to produce electricity.)

3. What does photovoltaic mean? (Photo means light; voltaic refers to Alexander Volta, who discovered voltage in electric currents.)

4. What happens when the sunlight strikes the silicon cell? (Photons of sunlight are converted to electrons; the positive (+) layer - boron - accepts the electrons; the negative (-) layer - silicon - rejects the electrons, thus setting in motion a direct current of electricity.)

5. What has been the principal use of solar cells? (used for powering space vehicles and satellites - over 1,000 space machines in all - all powered by solar energy)

6. If solar cells are so good, why don't we use them to produce electricity? (They are too expensive.)

7. Is there hope for future reductions in cost of solar cells? (Yes; new, cheaper materials and mass production techniques will lower costs.

8. Investigate development of the "Violet Cell."

Extending the lesson:

1. What is the possibility of mass production of solar cells? (According to Dr. William Cherry of the Goddard Space Flight Center in Greenbelt, Maryland, very good. He foresees highly automated assembly lines for production of silicon cells, which would reduce cost to $50 per kilowatt of electrical capacity.)

2. Read about the research of Dr. Mlavsky in mass production of ribbons from which cells could be cut. (Clark, page 389)

3. Describe your life with cheap solar electricity.

4. Investigate the use of solar cells to power the model family home at the Florida Solar Energy Center.

5. Celebrate Sun Day - May 3rd. Write to the Florida Solar Energy Center, 300 State Road 401, Cape Canaveral 32920.

Title: A Hydrogen Economy

Concept: Energy can be changed from one form to another.

Objective: To understand the potential of hydrogen as a fuel for the future

Introducing the lesson:

1. Show slides of the fatal explosion and fire which destroyed the Zeppelin Hindenburg at Lake Hurst, New Jersey in 1937.

2. Survey the class to see if any of the students suffer from the "Hindenburg Syndrome" - the label applied to the distrust and fear of hydrogen as a result of the Hindenburg tragedy.

Developing the lesson:

1. List the hazards of using hydrogen.

   a. It forms an explosive mixture with air.

   b. It has a low ignition point. (It is believed that the Hindenburg explosion was sparked by static electricity.)

   c. It burns with an intensely hot, colorless flame that can make its way out of the most minute opening.

   d. Its odorless characteristic makes it difficult to detect a leak.

2. Can hydrogen be used safely? (Leaking hydrogen gas diffuses so rapidly that it poses less of a hazard than gasoline. Dr. Derek Gregory, in Scientific American for January, 1973, argues that "Just as we have designed apparatus and procedures to enable us to fill our automobile tanks with gasoline and carry the resulting 20 gallon 'fire-bomb' at high speeds along a crowded highway and park it overnight inside our home, we can surely devise safe practices for handling hydrogen.")

3. Discuss the validity of Dr. Gregory's statement.

4. Investigate proposals for a "Hydrogen Economy," an economy based on hydrogen to replace fossil fuels. (See Clark in Suggested Readings.)

5. Investigate proposed uses of hydrogen:

   a. Dr. Gregory of the Institute of Gas Technology.

   b. Dr. William Heronemus of Amherst College (Windmills off the New England coast and a sea thermal power plant in the Gulf Stream off the Florida coast; both would use the electricity produced to make hydrogen from sea water by electrolysis.)

c. University of Miami hydrogen automobile. (Operates the same as with propane gas.)

d. hydrogen pipelines - could use existing gas pipelines.

e. fuel cells to convert hydrogen back to electricity.

5. How does a fuel cell work? (Hydrogen is fed to the anode, where it forms hydrogen ions and gives up electrons that travel along a circuit to the cathode; there oxygen combines with electrons and hydrogen ions to produce water.)

6. Set up a laboratory demonstration of water electrolysis.

Extending the lesson:

1. Investigate the formation of the Hindenburg Society. (a group of hydrogen-oriented scientists formed as a committee of the American Chemical Society on the 35th anniversary of the Hindenburg disaster, dedicated to the safe utilization of hydrogen as a fuel)

2. Discuss the limits to development of a hydrogen economy. (a lack of support from the energy companies; costs of production will be higher than present fuels; in the future it may represent an attractive alternative)

3. Complete the metaphor: "Hydrogen is ....."

4. Draw pictures showing your concept of:

   a. what hydrogen is like.

   b. what a hydrogen economy would be like.

5. Describe, without using words, hydrogen escaping through a tiny opening.

Title: The Age-Old Struggle For Power

Concept: People use energy to satisfy their needs.

Objective: To help students understand their need for power

Introducing the lesson:

1. Say: Many people fear that the disappearance of fossil fuels will doom civilization. If history is any guide, there is light at the end of the energy crisis tunnel.

2. What can we learn from history? (Every time an energy crisis has occurred in the past and the main sources of power dwindled, society found alternative power sources.)

Developing the lesson:

1. Ask: What was the first energy crisis? (It was probably when Paleolithic people ran short of food animals and started to grow their own plants and raise their own animals.)

2. When were energy machines first used? (Romans met their energy crisis - a lack of slave power - by developing water power. Before water power, human and animal labor had done all the work, even operating machines like treadmills and wheels.)

3. What happened when wood became scarce? (Coal was substituted and powered the Industrial Revolution.)

4. Discuss the reasons for the replacement of coal with oil despite the lack of a coal crisis. (Oil was cheaper, easier to get and transport, and cleaner to use.)

5. Look at the Twelfth Grade, Unit II, Lesson 2, on "The Second Coal Age."

6. Ask: Will coal again come to the rescue when oil supplies are gone, or is there another light at the end of the tunnel?

7. Why will the Second Coal Age be easier? (In 1700, there were no roads or railroads - all shipment was by water; canals had to be built.)

8. Investigate the construction and use of the Erie Canal across New York State to connect the East Coast and the Great Lakes.

Extending the lesson:

1. Discuss the role of energy in relation to the rise and fall of former civilizations.
2. Trace the influence on the development of civilizations of the discovery of:
   a. fire.
   b. sails.
   c. water wheel.
   d. windmill.
   e. steam engine.
   f. oil.
   g. internal combustion engine.
   h. electricity.
   i. nuclear fission.
3. Describe your lifestyle had you lived at the time of each of these new power inventions.
4. Write a paper on your vision of the "End of the Tunnel."
5. Describe our next new world of energy.
6. Predict how long the next energy supply source could last.

Title: Mileage

Concept: People use energy to satisfy their needs.

Objective: To understand the efficiency of automobiles

Introducing the lesson:

1. Say: We have been blaming the automobile for many of the problems of the energy crisis. Discuss the validity of this statement.

2. Ask: Who is really to blame? (The people who design, build, buy, and drive the cars; we are the ones who lead them to the pump and make them drink.)

Developing the lesson:

1. How much gasoline do the automobiles in the United States "drink?" (In 1979, about 80 billion gallons of gasoline for 110 million automobiles, which traveled over a trillion miles.) Compare with today's statistics, if available.

2. Investigate the effect of automobile weight and engine size on gasoline mileage: (about 1 percent loss per 100 pounds of automobile)

   a. subcompact -- 2,000 pounds -- 30 mpg.

   b. compact -- 3,000 pounds -- 18-20 mpg.

   c. standard -- 4,000 pounds -- 8-13 mpg.

   d. heavy -- 5,000 pounds -- 7-11 mpg.

3. Investigate the effects of tires and accessories on mileage:

   a. steelbelted versus bias tires -- plus 3 percent.

   b. power steering and brakes -- minus 2 percent.

   c. air conditioning -- minus 9 percent.

   d. automatic transmission -- minus 6 percent.

   e. proper tire inflation versus 5 pounds underinflated -- plus 3 percent.

4. Investigate the effects of speed on mileage for a standard sized car:

   a. typical city driving -- 9 mpg at 17 mph average.

   b. typical suburban driving -- 12 mpg at 25 mph.

   c. typical highway driving -- 14 mpg at 50 mph.

5. Investigate the effect of engine condition on mileage:

   a. one fouled spark plug -- loss of 10-15 percent.

   b. faulty igniton system -- loss of 8 percent.

   c. dirty air filter -- loss of 5 percent.

   d. improper carburetor adjustment -- loss of 5 percent.

   e. dirty carburetor and intake -- loss of 5 percent.

6. What are the approximate gasoline savings if United States motorists would:

   a. drive lighter, lower-powered cars. (15-50 percent)

   b. use properly-inflated, steel-belted radial tires. (6 percent)

   c. comply with 55 mph speed limit. (4 percent)

   d. eliminate one 5-mile trip per week. (3 percent)

   e. keep engines tuned. (5 percent)

   TOTAL Approximately 33 percent.

   Note: 33 percent represents more than one-half of the imported oil we use.

Extending the lesson:

1. Calculate the effects of a 30 percent saving of gasoline on the economy, balance of payments, energy supplies.

2. How many cars do Americans drive? (110 million - 45 percent of the world total)

3. Ask: What do you say to the "rubber-burner" who says: Who cares? -- It's my money!

4. Create a TV commercial to promote driving for better mileage.

5. Design a bumper sticker to tell your message.

6. Have it printed and distribute it throughout the community.

Title: "The 'Americar' Way"

Concept: People use energy to satisfy their needs.

Objective: To help students understand the relationship between people and cars

Introducing the lesson:

1. Ask: If America could have only one symbol, what would it be? (probably the wheel - or "wheels," the whole automobile)

2. Discuss what "wheels" symbolize. (transportation - the freedom to move)

Developing the lesson:

1. Examine and list the reasons Americans move. (for business and pleasure, or just because they're restless)

2. How far does the average American travel every year? (10,000 miles)

3. Sing the praises of American-style passenger transportation. (We live where we are comfortable, work where we are productive, play where it suits us.)

4. On the other hand, cars have been damned. Why? (They clog the courts, jam hospitals, pollute air and water, and are noisy, disturb neighborhoods, and make us dependent on foreign oil.)

5. How big a business is passenger transportation? (12 percent of the GNP; one-fifth of the labor force - 14 million workers; capital needs of $4 trillion between now and 2000)

6. Ask: What is "the 'Americar' Way?" (a way of life based on mobility via cars)

7. List the threats to this way of life. (There is no substitute, so inadequate fuel supplies threaten this way of life; even fuel conservation will not help because there will be more drivers, more cars; rising fuel prices have not stopped consumption.)

8. Is there any hope for a substitute fuel? (Yes, but alcohol, biogas, and hydrogen will all have lower power ratings.)

Extending the lesson:

1. Describe an American without an "Americar."

2. Design a car which uses low-powered substitute fuels.

3. Discuss the car of your future.

4. Discuss why Americans think they need a 5,000 pound vehicle with a 300 horsepower engine to carry one or two people.

5. Investigate people's fear of small cars.

6. Design a campaign to get people out of heavy cars and into lighter ones.

7. Describe the gasoline hoarder in some way, but without using words.

Title: Can We Afford Plastics?

Concept: People must choose between products made from scarce energy supplies.

Objective: To help students understand the need for wise use of scarce fossil fuels

Introducing the lesson:

1. Introduce the class to the "swizzle-stick syndrome" scenario:

   "Ours is a plastic world, populated by plastic people in plastic societies, cluttered with cheap plastic."

   This familiar lament is a compendium of symptoms, supposedly indicative of the ills of our times. For those who lament, the plastic swizzle stick is their symbol for whatever they deplore.

Developing the lesson:

1. How has our "plastic" language refashioned the meaning of the word "plastic" since its discovery a century ago? (from a word which described visions of bright new things to make life easier to the wonder of the film cellophane; to the synthetic substitutes of World War II and the promise of peacetime plastic in the world - to plastic as a derogatory word)

2. Why is plastic now said as a derogatory word? People think that plastics:

   a. use a large share of crude oil supplies.

   b. add huge energy costs to consumer goods.

   c. are responsible for overpackaging.

   d. litter the environment.

   e. create waste disposal problems.

3. Discuss the validity of this statement: All the above evils of our plastic society could be cured simply by suspending the manufacture of plastic products. (Less than 5 percent of world petroleum is used for petrochemicals, and less than one-third of this is for plastics; but consider also the energy used in the production of plastics.)

4. List the "plus" qualities of plastics. (Plastics are lighter, stronger, longer-lived, and more economical than wood, paper, glass, or metal. In total, they represent an energy advantage over alternative materials. For some plastics, such as artificial ear bones and heart valves, there are no substitutes.)

5. Investigate potential savings in the use of plastics for:

   a. transportation.
   b. home heating.
   c. industry.

6. Check the uses of plastics in the homes of the class. (foundation frames, plumbing, conduits, insulation, moisture barriers, carpet backing, countertops, floor and ceiling tiles, shower stalls and curtains, upholstery)

7. Ask: Why does a clothes washer and dryer cost less (proportionally) today than in 1960? (by using plastics)

8. Investigate the uses of synthetic fibers. (1 percent of the nation's petroleum produces 70 percent of the nation's fibers.)

9. Investigate the use of plastic mulch by Florida farmers in tomato and pepper fields. (controls weeds, conserves water, and enhances yields)

10. Investigate use of plastics in sports and recreation. (boats, paddles, bats, helmets, pads, artificial turf)

11. Investigate uses of plastics in medicine. (artificial organs, contact lenses, dental plates, artificial limbs, replacement blood vessels and bones)

Extending the lesson:

1. Debate the pros and cons of plastic packaging. (pro - convenient, clean, visible, prevents spoilage; con - much of our materials are overpackaged)

2. Draw a mural showing your reaction to the "swizzle-stick" syndrome.

3. Describe your plastic world.

4. Describe your world without plastics.

5. Identify the plastics in your automobile. (steering wheel, dashboard, paneling, roof, seats, cushions, fender, liners, grills, wiring, ducts, fan shrouds)

6. What is the advantage of using plastics in automobiles? (lighter, better fuel economy; the average car is 500-700 pounds lighter than a nonplastic car would be)

7. What are the comparative arguments for artificial versus natural Christmas trees? (renewable resource versus non-renewable for a social/religious event; safety; etc.)

Title: Energy Management For Schools

Concept: Energy supplies are limited.

Objective: To help students understand the need for energy conservation

Introducing the lesson:

1. Discuss the validity of this statement: If school officials are to deal effectively with their energy problem, it would be well to understand their sources; otherwise, they may be treating symptoms instead of causes.

2. Ask: Why are school administrators particularly vulnerable to difficulties created by energy shortages? (The private sector can write off or pass on increased energy costs, but schools cannot. Energy costs must be paid with a tax increase or an educational cutback, both deadly to school boards and administrators.)

Developing the lesson:

1. Contact the person responsible for energy use in school facilities. There is a person in each school district in Florida designated to manage the district's energy use. Have this person provide data on use of energy in your school and districtwide use. Get a copy of your school district energy management plan, if available.

2. How much energy do schools use? (11 percent of the nation's heating and cooling energy; 500 million gallons of gasoline for buses; 18 million gallons of gasoline per year for driver training)

3. Why do schools use so much energy? (Public school systems are usually the largest employer, manage the largest food service operation, operate the largest transportation system, and house the largest number of people on a day-to-day basis of any single institution.)

4. Investigate your school's energy use for:

   a. heating, cooling, and lighting.

   b. transportation.

   c. driver training.

   d. food service.

5. Trace the path of energy into and out of your school.

6. Calculate the added cost of the nation's school use of 518 million gallons of gasoline if the present cost of $1.25 per gallon increases 15¢ per gallon; 25¢ per gallon; reaches $2 a gallon.

7. Discuss why many schools are unprepared during times of energy shortages .

8. Discuss what your school can do to plan for times when energy supplies are curtailed or a crisis situation exists.

Extending the lesson:

1. Discuss the long-range effects of an energy crisis in terms of:

   a. taxation.

   b. educational programs.

   c. teacher salaries.

   d. night athletic contests.

   e. busing.

   f. field trips.

2. Interview your principal to determine energy costs per month, miles driven by school buses, gasoline use.

3. Calculate mileage (miles per gallon) for your school buses.

4. Make a census of faculty and student cars.

5. Map the routes driven by each.

6. Devise and implement a carpooling plan for your school.

7. Calculate gasoline savings if all students and teachers who ordinarily drive cars to school rode on buses instead.

8. Start a school campaign to reserve parking spaces for carpool drivers.

9. Design a sign to urge energy conservation in your school.

10. Initiate a community campaign.

Title: Natural Limits To Energy Supplies

Concept: Nature imposes limits on energy supplies.

Objective: To help students understand the natural forces which limit energy supplies

Introducing the lesson:

1. Find stories and pictures of oil workers on drilling platforms in the Gulf of Mexico, the North Sea, or on the frozen North Slope of Alaska's Brooks Range.

2. Ask: Why are people searching for oil in these harsh environments? (Because easy-to-get oil has been discovered and used already.)

Developing the lesson:

1. Ask: What are the natural limits to oil supplies? (depth of wells, depth of water, distance fuels must be transported, location, amount, grade)

2. Investigate the depths of record oil wells. (The record is 31,441 feet in Oklahoma, 1974; 23,400 feet in Wind River, Wyoming.)

3. What is the cost of such a record well? (The Wind River well cost $5.2 million, or $244 per foot.)

4. Compare record wells with former record holders. (In 1859, the first oil well at Titusville, Pennsylvania was 69 feet deep; record in 1927 was 8,046 feet in California; in 1935, 12,786 feet in West Texas; in 1945, 16,655 feet on the Gulf Coast of Texas; in 1956, 22,570 feet in Louisiana.)

5. What is the Florida record well? (18,670 feet, drilled by Bass Enterprises in the Jurassic Formation in Collier County, 1975)

6. Investigate oil production in Florida. (Jay Fields in north Florida are producing the most oil at this time.)

7. Locate on a map the location of OPEC nations, and trace the routes for tankers to the United States. Be sure to include routes from Venezuela to Florida's east and west coasts.

8. Investigate problems for each route. (tanker size, port facilities, weather, cost)

9. Check the validity of this statement: Alaskan or offshore oil will equal only a few years' supply of oil. (True, even at present rates of use.)

Extending the lesson:

1. Discuss the environmental importance of the grade of crude oil. (Using heavy oils is more expensive and more polluting; high sulfur oils are banned in many places.)

2. Look for information about life on an oil rig.

3. Read about the accident at the "hotel" rig in the North Sea, off the Norway coast, in March of 1980 and another North Sea accident in 1982.

4. Investigate the natural limits of other minerals.

5. Discuss the claim of the oil companies that there is much more oil to be discovered if only the government did not regulate and tax their profits.

6. Discuss the present federal policy on leasing offshore and public lands for oil exploration.

7. Investigate environmental consequences of the discovery and use of Alaskan oil. (spills, caribou migrations interrupted, tanker transport to the West Coast)

8. Discuss the difference between oil resources and oil reserves. (Resources are what exists; reserves are what you can get out with available technology.)

Title: Environmental Costs Of Electric Power

Concept: Production of electricity affects the environment.

Objective: To understand the environmental costs of electricity

Introducing the lesson:

1. Present this scenario: The United States is now facing three problems, all of which are called "crises" by some scientists, economists, and environmentalists. They are: electric power supply, environmental quality, and overpopulation. These three problems are closely related. Power generation is a large contributor to environmental pollution; electricity supports an endless list of business, industrial, and domestic activity; population growth increases demand for electricity.

Developing the lesson:

1. Discuss how population growth and growth of power production compound environmental problems. (The expected population is 300 million by the year 2000.)

2. Discuss how increased per capita consumption adds to the demand for electricity.

3. Investigate recent trends in the demand for electricity. (Since the 1973 oil crisis, Americans have been using far less electricity than predicted, and analysts predict even less growth in the future. Florida demand continues to increase but at a slower per capita rate in the last few years.)

4. Discuss the implications of this decreasing use of electric power. (fewer utility rate increases; new power plants; reduced new pollution; possible easing of the nuclear debate)

5. What is the actual cost of electricity? (The cost of kilowatt used, new plant construction, and accidents like Three Mile Island are all included in utility bills.)

6. Discuss the "free" use of the environment for waste disposal by utilities.

7. Discuss the question: Why more power? (Electricity use has been equated with the standard of living.)

8. Consider the environmental costs of transmission lines. (Lines require 100 acres per mile.)

9. What are the alternatives to long transmission lines? (building plants close to communities which use the electricity. People do not want to live near a plant.)

10. Investigate chemical water pollution by power plants. (Chlorine is added to water to protect machinery; biocides are added to prevent buildup of slime in condensers; other compounds are added to control acidity of cooling water.)

11. Review lessons on nuclear power plants.

Extending the lesson:

1. Investigate alternative sources of fuels to produce electricity.

2. Investigate how power plants are sited. (Siting depends on type, location of consumers, fuel sources, zoning laws, winds, availability of cooling waters, transmission requirements.)

3. What are the choices available to people? (To have no additional power production, or choose a form of power that will have minimum impact on the environment.)

4. Discuss class reaction to a power plant proposal for your community, or on your favorite river.

5. Design a plan to conserve electricity for your local community.

6. Implement your plan.

Title: People View the "Crisis"

Concept: The energy crisis has different effects on people.

Objective: To understand how energy shortages affect the lifestyles of people

Introducing the lesson:

1. Turn off the lights at the beginning of the class period and pretend that there has been a "blackout."
2. Ask the class what they would recommend as a course of action.
3. List the class suggestions.

Developing the lesson:

1. Survey the class to determine how the students view the crisis.
2. Discuss whether the present energy situation is really a "crisis" or a new and lasting situation.
3. Design a survey form to determine community awareness of the energy situation.
4. Conduct the community awareness survey.
5. Investigate survey results.
6. Discuss general community attitudes concerning energy.
7. Discuss people's concerns about changing lifestyles.
8. List the principal changes in people's lifestyles as a result of the energy situation.
9. Look for articles dealing with community programs to conserve energy. (Fitchburg, Massachusetts; Portland, Oregon; Davis, California; etc.)
10. Discuss the applicability of these programs to your community.

Extending the lesson:

1. Design a mural to illustrate the changes in your community as a result of an energy crisis.
2. Design and prepare a billboard to promote energy awareness in your community.
3. Use class billboard designs to create poster and T-shirt messages.

Title: The Geography Of Energy

Concept: Nations depend on one another for energy supplies.

Objective: To understand the international relationships in energy supply

Introducing the lesson:

1. The United States imports about one-half of its oil supplies. Ask:
   a. Where are the world's oil supplies located?
   b. Where are the world's oil users?
   c. How does the oil get from supply location to users?

Developing the lesson:

1. On a world map, locate the major oil producing nations from whom we are importing or have imported oil. Mark them with a red flag. (Venezuela, Saudi Arabia, Iran, Iraq, Libya, Nigeria, Algeria, Mexico, Canada, Great Britain)
2. Locate the major importing nations. Mark them with a blue flag. (United States, Japan, Western Europe)
3. Trace the major oil tanker routes from the producing to the importing nations.
4. Trace the route from Venezuela to Florida's Tampa Bay, to Port Everglades and Jacksonville. (crude oil, gasoline, and refinery residual oil for power plants)
5. Investigate the importance of the Suez and Panama Canals in oil shipment. (The canals are not important. The new supertankers are too large to pass through; they must go around Africa and South America.)
6. Investigate the formation and activities of the OPEC nations. (Oil Producing and Exporting Countries have joined together to determine prices for oil and to form a uniform policy for exports and production.)
7. Locate the Prudhoe Bay oil region in Alaska north of the Brooks Range.
8. Trace the route of the trans-Alaska pipeline from Prudhoe Bay to Valdez, and then the oil tanker route to the West Coast of the United States.
9. Investigate proposals to build a natural gas pipeline from Prudhoe Bay across Canada to the midwestern United States.

10. Discuss why a natural gas pipeline is important. (Natural gas is an important and extensive additional fuel source which will be wasted if not piped out. Shipping would be difficult because of ice, and the energy supply is needed in the Midwest, not on the West Coast.)

11. Investigate the problems of crossing Canada. (Canada has agreed to the construction of the pipeline, but, of course, will want a share of the gas being transported.)

Extending the lesson:

1. Investigate the location of the world's coal and uranium reserves.

2. Discuss changes in the power of energy after oil supplies are used up. (Power would shift from oil-rich nations to nations with coal, uranium, or solar technology.)

3. The discovery of oil in Mexico was greeted in the United States as an answer to our energy crisis. Ask: Why is this not so? (Mexico has decided to exploit its oil resources slowly to conserve supplies, and the oil they do provide for export will be at World - OPEC - prices.)

4. Discuss the validity of Mexico's decision. (Why should they pump out all of their oil to feed the wasteful energy habits of people in the United States?)

5. Predict the effect on Florida's environment if coal is used to fuel power plants instead of oil.

6. Select a route for the proposed coal slurry pipeline from Appalachia to Florida. (Contact Continental Resources in Orlando for information about the proposed coal slurry pipeline.)

7. Investigate possible environmental effects of such a coal slurry pipeline. (What will happen to the slurry water after the coal is taken out in Florida?)

8. Investigate the status of the pipeline from the U.S.S.R. to Western Europe.

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Title: Divestiture -- Why? Or Why Not?

Concept: Energy comes in many forms.

Objective: To understand the relationship between the different forms of energy

Introducing the lesson:

1. Many economists say that the American private enterprise system is at a crossroads. Questions are being raised about the total control of all kinds of energy resources by a few giant energy companies and the effect of this on free market competition among the various energy sources - coal,oil, uranium, natural gas.

2. Ask: What is meant by "Big Oil"? (This is a catch phrase to describe the largest oil companies.)

Developing the lesson:

1. Investigate congressional attempts at divestiture - the breakup of the energy company's monopoly on energy supplies; for example, an oil company would have to "divest" itself of its holdings of coal or uranium to avoid monopoly or lack of competiton. (Request information from your Congressman's office.)

2. Who owns Big Oil? (14 million American stockholders own stock in the six largest energy companies. In comparison, in 1900 John D. Rockefeller owned 43 percent of the old Standard Oil Company.)

3. Discuss the pros and cons of divestiture laws. (There would probably be more competition for the energy dollar, but only the giant corporations can afford the tremendous costs of exploration and research to develop new sources of energy supply.)

4. Why do energy companies feel that divestiture is unfair? (It is sound business for them to take active roles in bringing alternative forms of energy to the marketplace; on the other hand, it would mean the end of an oil company if it did nothing to diversify in view of the end of oil supplies.)

Extending the lesson:

1. Draw a picture or cartoon promoting divestiture.

2. Now draw another picture or cartoon promoting the industry position. (Be sure to include yourself in both.)

3. Write a "letter to the editor" telling how you feel about congressional legislation to affect divestiture.

4. Compare the "monopoly" of the oil companies with other industries. (four big tire companies; four big automobile companies; four big steel companies; four big aircraft companies, etc.)

5. Discuss why the oil companies seem to be "picked on." (Oil companies are more visible and their products reach the lives of every American every day; also, many Americans blame the oil companies for the economic situation and the energy crisis.)

6. Investigate what happened during the time when the government had price controls and "old oil" (domestic oil from old wells) and the "daisy chain" scandal. (Some oil companies and dealers became involved in selling and reselling "old oil" - which could be sold only at a much lower price than imported oil - until the oil became as expensive as "new oil" - imported oil.

Title: Supply Problems

Concept: It takes energy to get energy.

Objective: To understand the energy cost of getting energy

Introducing the lesson:

1. Ask: Where will tommorrow's oil and gas come from? Energy sources will be farther away, deeper in the ground or under the sea, in harsh environments.)

2. What will be the supply problems for energy from increasingly difficult environments? (Enhanced recovery technology will be extremely difficult at deeper levels and offshore; transportation will be more difficult and over longer distances; in short, it will take a great deal more energy to bring new fuel supplies to the market; net energy balance will be lower.)

Developing the lesson:

1. Compare the first oil well at Titusville, Pennsylvania, with a North Sea well. (In 1858, the first well was 69 feet deep; the oil was a light, low sulfur oil, easy to refine; North Sea oil is miles down, far out in a stormy sea, far from transportation and refineries; the oil is thick and heavy, may be high in sulfur, and, most important, is difficult to refine into today's most usuable fuel - gasoline.)

2. Investigate where future oil is most likely to be found. (Oil geologists predict that 60 percent of the undiscovered oil is in already productive basins. The remaining 40 percent is in unexplored areas, most of these in harsh environments or in water as much as a mile deep, or both of these.)

3. Discuss the problems of supply from the areas predicted to hold most of the "unexplored" oil.

4. Discuss the increased costs of oil resulting from the lack of refineries near offshore wells on the Atlantic coast of the United States.

5. Investigate the following problems of energy supply:

   a. federal leasing of offshore and public lands. (Write to Bureau of Land Mangement, Department of the Interior.)

   b. mine safety regulations.

   c. labor costs and disputes.

   d. energy used in exploration.

   e. energy used in transportation of oil to refineries.

f. price controls.

g. distribution controls.

h. nuclear safety.

i. nuclear waste disposal.

j. depletion allowances.

k. antitrust, monopoly, divestiture.

l. environmental costs - spills, spoil, dumps, pollution.

Extending the lesson:

1. Discuss the validity and implications of this statement: It takes several years between discovery of new energy sources and their availability on the market. (consider Alaskan pipeline, offshore, shale oil, North Sea, etc.)

2. Has this been true historically? (Yes; it takes years to set up new supply lines.)

3. Create a billboard to promote a new energy source.

4. North Slope, Alaskan oil has been called a "bonanza - with problems." Is this a valid judgment?

5. What are the problems? (difficult environment, long pipeline, permafrost, maintenance, environmental costs)

6. Is it a "bonanza"? (Yes, but at present rates of use, the estimated reserves will last only a few years.)

Title: Mini-Battery

Concept: Energy comes in many forms.

Objective: To understand the problems of energy storage

Introducing the lesson:

1. Show the students a flashlight battery and ask them to list the advantages and disadvantages of using batteries as a source of electric power. (They are portable, but do not last very long and are affected by the environment; net energy is poor.)

2. Discuss why people have been unable to develop a method for storing electricity. (Electricity by its nature is moving - even batteries only hold the materials to generate an electric current.)

Developing the lesson:

1. Write to the Battery Division, Exxon Enterprises, Inc., Department R, Post Office Box 1074, Somerville, New Jersey 08876 for information on the newly developed "mini-battery."

2. What makes the "mini-battery" so special? (It is the first commercial rechargeable lithium battery.)

3. How is this battery different from conventional batteries? (It has a higher energy content, the ability to be recharged by either solar or conventional power, has a leak-proof seal, has stability over a wide range of operating temperatures, and a "sloping voltage" output.)

4. What is a "sloping voltage" output? (Most batteries operate at nearly full power until their energy is nearly exhausted and then fail abruptly; the "mini-battery" voltage lowers gradually from 2.4 volts to 1.9 volts as its energy is used up; a simple meter tells that the unit needs recharging.)

5. Compare "brownouts" in electric supply from power plants to "sloping voltage."

6. Why is "sloping voltage" important in computers? (This can prevent loss of data stored in memory cells when a computer stops due to loss of power.)

7. Investigate the potential of the "mini-battery" to store energy from the sun. (solar-powered wristwatches, portable tools, calculators, etc., which require a standby power reserve)

Extending the lesson:

1. What are the advantages of using lithium in the battery? (It is the lightest of all metals, important in portable tools and instruments.)

2. Discuss the effects of the inability to store electricity when planning power plants. (Because electricity cannot be stored, power plants must be large enough to supply the maximum "peak" power demand.)

3. What is the alternative? (brownouts or blackouts during peak demand periods or monitoring demand and shedding selected loads)

4. Discuss why people would need or want a solar-powered wristwatch that needs reserve batteries rather than a watch that needs a winding once a day.

5. Become famous - find a way to store electricity!

Title: Pay Now -- Or Pay Later

Concept: Energy comes in many forms.

Objective: To understand the total energy costs of gasohol

Introducing the lesson:

1. Ask: Booze in the gas tank? How about it? (To hear some people tell it, the answer to all the world's energy problems is gasohol, a mixture of unleaded gasoline and 10 percent ethyl alcohol - or grain alcohol.)

2. Survey the class to see how many have used gasohol in their automobiles.

Developing the lesson:

1. Discuss the following statements about gasohol by political leaders promoting its use: "Gasohol will save us when oil production peaks out"; "It will eradicate urban pollution"; "It will allow taxpayers to stop paying farmers not to grow food"; It will ease the 'slow-death' greenhouse effect occurring on the planet"; "Our cars will have more zip"; "Auto makers will be able to meet government mileage standards"; and "Americans will be able to drive big cars again."

2. What special interest groups are promoting the use of gasohol? (farmers, timber producers, environmentalists, minorities, people worried about the United States trade balance, the American Automobile Association, Florida and U.S. Departments of Agriculture)

3. Discuss the reasons for the wide support of gasohol. (Alcohol can be made from just about any organic matter - grain, grain by-products, such as straw and corn husks, contaminated grain - now thrown away - sugar cane, potato peels, wood and wood by-products, garbage, and sewage.)

4. Investigate incentives for gasohol production. (The Energy Bill has a 4 cents per gallon tax waiver for gasohol at the pump, which means a 4 cents per gallon subsidy to alcohol manufacturers; the U.S. Department of Agriculture has awarded $15 million in loan guarantees for new alcohol distilleries; Senator Frank Church, D - Idaho, has introduced a bill to mandate a switch to gasohol by 1990.)

5. So why isn't gasohol more widely available? (There are few investors because market is small - only 10 percent is alcohol. Without government subsidies, gasohol is not price-competitive, and the tax waiver expires in 1984. Raw materials may become too costly - they are grown with fossil fuels; and the oil companies do not want gasohol.)

6. What are the advantages of gasohol? (It increases the octane rating of unleaded gasoline; will extend the life of gasoline supplies by 10 percent; can be made from many wastes that are now thrown away.)

7. Investigate and discuss the net energy implications in producing gasohol.

8. How would the United States food supply be affected by large-scale production of gasohol?

Extending the lesson:

1. Investigate the alcohol car made by Henry Ford.

2. Ask: Shall we pay now - or pay later? (Who knows what the OPEC nations will be charging for oil in the future. Alcohol from wastes may be cheaper in the long run; on the other hand, production of food is already an energy-losing proposition, so using fossil fuels for the production of grain to make alcohol would not seem to be a wise idea.)

3. Why are the oil companies against the use of gasohol? (Separate tanks are needed, a whole new distribution system is required, and they do not control the production of alcohol.)

4. Why are the auto makers against gasohol? (Gasohol, with more than 15 percent ethanol, would require major engine modifications.)

5. Discuss the environmental effects of gasohol use. (It should reduce emission pollutants by 10 percent, since the alcohol itself is non-polluting.)

6. In 1978, Florida had 300,000 acres planted in corn. A good yield is 80 bushels per acre. Since a bushel of corn can make up to 2.6 gallons of alcohol, how much alcohol could Florida produce? (62.4 million gallons)

   Florida uses 5 billion gallons of gas per year. How much would this displace? (1.2 percent)

Title: The Second Coal Age -- Dig We Must!

Concept: Energy comes in many forms.

Objective: To understand the role of coal in our energy future

Introducing the lesson:

1. Ask: What does this statement mean: Coal was to human society what yeast is to bread - the essential starter.

2. Discuss what the statement means in terms of:

   a. the industrial revolution.

   b. national wealth-United States, England, Germany, etc.

   c. electricity.

   d. transportation.

Developing the lesson:

1. Coal had been known for a long time; long before it was widely used. Why? (Coal was not used until the favorite fuel - wood - was no longer plentiful.)

2. Discuss why people have so little affection for coal. (It is dirty, polluting, and dangerous to mine.)

3. People now envision a Second Coal Age. Discuss the reasons for this view of future energy sources. (The use of coal was discontinued when oil was discovered and became plentiful; soon oil will be in short supply and coal is the possible alternative fuel to power our industrial society.)

4. Investigate the "costs" to the United States of the First Coal Age. (100,000 miners killed AND MORE THAN 1 MILLION DISABLED in mine accidents. The government pays "black lung" victims $1 billion per year in benefits; the costs of pollution cannot even be calculated.)

5. Investigate the environmental effects of the use of coal as a fuel. (Coal-fired power plants emit 50 percent of the sulfur dioxide in our air; acid drainage from mines has polluted streams, poisoned wells, even corroded cement; nearly one-half million acres of land have been "stripped" for coal and never reclaimed - "orphan lands"; whole sections of Appalachia are impoverished.)

6. Is the supply of coal inexhaustible? (Not at all. If coal consumption rises at the rate recommended, reserves will be exhausted in 74 years, according to physicist Albert Bartlett.)

7. Who owns the coal reserves? (a few coal companies; several oil companies; two railroads; Indians - 10-15 percent is on Indian reservations no one wanted a few years ago. Most of the western coal is on federal lands and is available under leasing by the Bureau of Land Management, Department of the Interior.)

8. Will coal be cheaper than other sources of energy? (No; coal shows every indication of costing as much as oil. When the price of oil quadrupled, the price of coal rose from $8 a ton to as much as $45 a ton; states are also starting to tax the coal mined. For example, Montana imposes a $20-$30 tax per ton.)

Extending the lesson:

1. Who were the first Americans to use coal? (Hopi Indians used coal to heat homes and fire pottery as early as the 11th century.)

2. What will be the major impact of the Second Coal Age? (It may halt United States dependence on imported oil and the economic burden this causes.)

3. Investigate the "Gillette Syndrome." (The boom town effects of western coal mining, named after the town of Gillette, Wyoming, where western coal mining has had its greatest impact.)

4. Can coal be used without endangering human health? (Mining will always be a hazardous occupation, but coal can be burned cleanly if people want to spend the money necessary to remove the polluting agents.)

5. Investigate the effects on the environment of burning coal. (Soot contains benzopyrene, the carcinogen in cigarette smoke. 14 toxic heavy metals are found in U.S. coal. Radioactive isotopes in coal would add to radio-activity of the air - some say more than nuclear plants. Burning coal could add as much nitrogen oxides as all the cars in the United States; and 600 million tons of carbon dioxide per year.)

6. Draw a picture of your community in the Second Coal Age.

7. Describe it.

NOTE: Before teaching these next two lessons, teach Grade 11, Unit II, Lesson 3

Title: The Anti-Nuclear Lobby

Concept: Energy comes in many forms.

Objective: To understand the reasons why some people want to halt the use of nuclear power for the generation of electricity

Introducing the lesson:

1. Read the following: Alfred E. Neuman has taken a stand. The October 1979 issue of MAD magazine depicts the "what, me worry?" kid in front of a nuclear power plant with cracked cooling towers. Sweat is pouring off the normally nonchalant visage as Alfred says, "Yes....Me Worry!"

2. Then present this scenario: Critics of nuclear power now allege that if we continue to rely on it for power, we lay ourselves open to explosions, meltdowns, cancer, poisoning, terrorism, repression, war, and impoverishment.

3. Who are the representatives of the Anti-Nuclear Lobby? (They range all the way from Nobel Laureates, politicians, Ralph Nader, Friends of the Earth and other environmentalists, Maggie Kuehn's Grey Panthers, to actress Jane Fonda and her husband, activist Tom Hayden.)

Developing the lesson:

1. What is the goal of the Anti-Nuclear Lobby? (They want no new nuclear power plants built and want the complete shutdown of all nuclear power plants in the United States, at least until safety and radioactive waste disposal problems have been resolved.)

2. Research the activities of the "Clamshell Alliance" in opposing construction of a nuclear power plant at Seabrook, New Hampshire, in 1978 and 1979. Research the Diablo Canyon situation in California.

3. Discuss the Tom Hayden statement at the Critical Mass Conference (October 5-8, 1978, in Washington, D.C.): "The anti-nuclear struggle should be to America during the Eighties what the anti-war movement was in the Sixties."

4. Investigate the tactics used by the Anti-Nuclear Lobby at the National No Nukes Strategies Conference at Louisville, Kentucky (August 15-18, 1978). (The proposal to stage "Nuremburg" trial of Joseph Hendrie, Chairman of the Nuclear Regulatory Commission.)

5. Investigate the anti-nuclear rally staged in New York in June, 1982.

6. Investigate special groups formed to attack each segment of the nuclear power industry. (generation of electricity; transportation of materials; decommissioning of power plants; export of nuclear technology; sale of nuclear facilities to foreign nations; and groups to directly occupy sites)

7. Investigate the effects of the Three Mile Island accident on the activities of the Anti-Nuclear Lobby. (That accident has increased public concern over the safety of plants.)

8. Investigate anti-nuclear sentiment in Florida. (Previously, there did not seem to be much except for environmental concerns. A University of Florida study showed 60 percent favored nuclear expansion before Three Mile Island. Investigate attitudes of people today.)

Extending the lesson:

1. Dream up a slogan for a new anti-nuclear group.

2. Debate the following topics:

   a. nuclear plants are more reliable.

   b. the breeder reactor could solve our electric energy problems.

   c. the breeder reactor should be built as an "insurance policy" if other fuel supplies are exausted.

3. Evaluate the objectivity of the media in reporting news on nuclear power matters. (Power advocates blame the media for the general lack of confidence of the American public.)

4. Compare health and safety records of nuclear, coal, and oil fueled power plants.

   a. coal - costs many lives and injuries; air and water pollution.

   b. oil - tanker spills; well blowouts offshore; air and water pollution.

   c. nuclear - so far has not caused any instantaneous deaths, but effects of radioactive wastes on future generations could be serious - or negligible.

5. Compare the operating records of coal, oil, and nuclear plants over a period of time (5 years or so).

Title: The Unanswered Question -- Nuclear Wastes

Concept: Energy can be changed from one form to another.

Objective: To help students understand the problem of nuclear power plant waste disposal

Introducing the lesson:

1. Ask: What will we do with nuclear wastes? (We do not know; this is the great unanswered question in energy today.)

Developing the lesson:

1. Investigate the types of nuclear wastes.

   a. low-level wastes (LLW) - nuclear "junk" which contains small amounts of radioactivity, as mine equipment, laboratory clothing, gas filters, etc.

   b. mill and mine tailings - residue after the .2 percent of uranium is removed from the ore, but still radioactive.

   c. airborne emissions - reactors routinely vent small amounts of gaseous radioactivity, including krypton 85, xenon 133, iodine 131, and carbon 14; radioactive particles can travel around the globe in the air.

   d. intermediate waste liquids - actinides, formerly buried in trenches at Hanford, Washington, and Barnwell, South Carolina; now stored at Idaho National Engineering Laboratory despite pressure on the Department of Energy to remove it. (to where?)

   e. high-level wastes - spent fuel assemblies or the fission products and actinides left in spent fuel after plutonium and uranium are removed by reprocessing; these include strontium 90 and cesium 137; 37 million gallons now await disposal.

   f. spent fuel - old fuel rods (after three years), no longer able to sustain the nuclear reaction, are removed to a "pool" for cooling and storage; there is only one "pool" for cooling and storage; there is only one "pool" in the United States, a General Electric plant at Morris, Illinois, now holding 5,000 tons of spent fuel, with a total of 71,000 tons expected by the year 2000.

   g. old nuclear power plants - no method of disposal.

2. Write to the Energy Research and Development Administration of the Department of Energy for information on methods and problems of nuclear waste disposal for each of the types of waste.

   a. mill and mine tailings - until 1965, used for roads and building materials; then health officials detected a high incidence of cancer in people living in homes made from mine tailing blocks; they were even used to build schools in Colorado.

   b. low-level wastes - once solidified in cement and dumped at sea; LLW's at Nevada test site are pumped 1,000 feet underground into a cavity created by a nuclear explosion.

   c. high-level wastes - tanks at Hanford and Barnwell are leaking and being replaced by double steel tanks for "interim" storage; at West Valley, New York, 600,000 gallons await disposal.

   d. spent fuel - industry wants to keep as an energy resource for reprocessing into plutonium and uranium.

3. Investigate proposals to store wastes in underground salt domes.

4. Write to the Sierra Club Radioactive Waste Campaign, Box 64, Station G, Buffalo, New York, for information about environmental concerns regarding nuclear waste disposal methods and proposals.

5. Investigate the costs of keeping nuclear wastes. (The 1978 ERDA, DOE budget for "maintaining" existing military wastes and "to come up with some kind of plan for the future" was $290 million.)

6. The cost for total waste disposal? (Estimates in 1976 were as high as $600 million for disposal of the 600,000 gallons of wastes stored at West Valley, New York, alone, with over 80 million gallons now in storage. The cost was projected to be as high as $80 billion - if we had the technology to complete such disposal. Research the estimates given today.)

Extending the lesson:

1. How serious is the shortage of storage space? (Government scientists say some facilities may be forced to close by 1985 unless a disposal method is found.)

2. Discuss the idea of storing wastes in your area.

3. The Department of Energy has spent nearly one billion dollars on disposal technology. What plans have emerged? (Only the plan to use underground salt domes for disposal has been suggested.)

4. Are states opposing burial of wastes? (Yes; South Carolina has refused to accept shipment of even LLW from Three Mile Island; eight other states have banned nuclear waste depositories and others are considering similar action.)

5. Investigate where nuclear wastes from Florida are being stored at the present time.

6. Ask: Is electricity from nuclear reactors worth the risk?

Title: Lifestyles And The "Energy Crisis"

Concept: Energy can be changed from one form to another.

Objective: To understand the relationship between the standard of living and energy use

Introducing the lesson:

1. Say: The shortest sentence in President Carter's 1980 State of the Union Message to the Congress had only two words, "Eliminate waste"; a sentence of great domestic import in a speech devoted almost entirely to world affairs.

2. Ask: What did the President mean?

Developing the lesson:

1. Discuss the class reaction to the President's appeal. (who - me?)

2. Have the students list ways they waste energy in:

   a. school.
   b. home.
   c. transportation.
   d. shopping.
   e. their community.

3. Make an energy and materials waste survey in your community.

4. Discuss how each example of waste could be eliminated.

5. Discuss how the energy situation and the resultant high prices of fuel may tend to eliminate waste.

6. Make a class list of things that were formerly thrown away which are now being saved. Then make a list of things that should be saved or recycled.

7. Make a list of changes in modes of living. Consider:

   a. high mileage cars.
   b. walking and bicycling.
   c. insulation to reduce heat and air conditioning waste.
   d. do-it-yourself trend in repairs, etc.
   e. use of older clothing, shoes, etc.
   f. recycling wastes - metal, paper, aluminum, glass.
   g. use of leftover food.
   h. turning out the lights when not in use.
   i. secondhand markets - cars, clothes, etc.

8. Describe the American "throw-away" society.

9. Discuss the difference between a changed lifestyle and a change in wasteful habits.

10. Survey the class to determine the number of patched, used, or mended articles being worn or used.

11. Describe how gasoline rationing would affect your lifestyle.

Extending the lesson:

1. Does your description of your lifestyle under gasoline rationing indicate that you are using more than your share?

2. Investigate the motives for the new spirit of energy conservation. (financial; general atmosphere of crisis)

3. Draw a picture of a "frugal" you.

4. Describe a more frugal lifestyle for you.

5. "Waste Not - Want Not" was once a popular American motto. Design a motto for the new frugality.

6. Were early Americans entirely thrifty? (Definitely not - they squandered resources and wildlife on a tragic scale.)

7. Compare the effects of an energy crisis with the effects of a doubled population for the United States. (That means twice as many people competing for the resources of the nation.)

8. Design a campaign to gradually adapt to limited energy supplies.

9. Design billboard, TV, radio, and T-shirt commercials for a simpler lifestyle.

10. Discuss how energy demand is related to standards of living:

    a. size of house.
    b. type of transportation - gas guzzler, subcompact, diesel, bus, or walk?
    c. number of appliances.
    d. income.

11. List the social activities which require transportation, and predict changes if travel is restricted.

12. Compare space and energy requirements of people with different lifestyles.

13. Do the same for wildlife. (herd or solitary)

Title: The Environment And The "Energy Crisis"

Concept: Energy can be changed from one form to another.

Objective: To understand the environmental effects of energy use

Introducing the lesson:

1. Say: One observer, speaking of the effects of energy uses on the nation's environment, said: "The recent upsurge of public concern over environmental questions reflects a belated recognition that people have been too cavalier in their relations with nature. Unless we arrest the depredations that have been inflicted so carelessly on our natural systems, we face the prospect of ecological disaster."

2. Ask the students to guess whether the speaker was: (a) an environmentalist; (b) a politician; (c) an economist; (d) none of these. (The speaker was President Nixon, quoted in a report of the Council on Environmental Quality, "Environmental Quality," Washington, D.C., 1979, page 5.)

Developing the lesson:

1. List the "depredations" associated with:

   a. energy supply - coal mining, oil exploration and transportation, shale oil, firewood.

   b. energy use - coal, oil, gasoline, nuclear.

   c. transportation - smog, nitrogen, oxides, sulfur oxides, carbon monoxide; also amount of land covered with highways, service stations, etc. - 60 percent of Los Angeles is covered with roads, service areas, shopping centers.

2. Discuss the measures being taken to reduce these effects on the environment. (Clean Air Act; Clean Water Act; National Environmental Protection Act; state and local ordinances and laws to control pollution and waste disposal)

3. Investigate the role of the Florida Department of Environmental Regulation and the present policy of the Environmental Protection Agency in Washington, D.C.

4. Discuss the environmental effects of energy use in terms of climate. (The greenhouse effect is caused by excess carbon dioxide from burning fossil fuels; cities have more clouds, fog, and rain; less sunshine; higher mean temperatures.)

5. Discuss the validity of this statement: There is no pollution-free energy in this world of ours. (The elimination of entropy is impossible - Second Law of Thermodynamics.)

6. Some economists and business people consider the environment a "free" area for dumping the wastes. What is the implication of this view? (Such economic decisions do not take into account the costs to the environment.)

7. Investigate environmental changes caused by the energy "crisis." (Many states and cities are not allowing the use of high sulfur oil and coal in electric power plants, and there is a persistent demand for relaxation of environmental standards for air and water pollution.)

8. What is smog?

Extending the lesson:

1. Investigate the major oil spills. (Santa Barbara, Ixotec)

2. Investigate major spills from oil tanker accidents. (Torrey Canyon, etc.)

3. Investigate the possible effects of a spill of liquid natural gas - LNG. (The greatest potential for mass destruction of any technology except nuclear; an LNG tanker that ruptures in New York harbor, for example, could flood New York City with flames - the fire would follow back to the ship from the point of ignition.)

4. Research the hazards of deep mining of coal.

5. Predict the environmental effects of a coal slurry pipeline to bring coal to Florida for electric power generation. (The biggest problem probably will be what to do with the slurry water, which will resemble the acid mine wastes that destroyed the streams of Appalachia.)

6. What have auto exhaust emission control devices cost in terms of increased fuel consumption? (6 billion extra gallons in 1979)

7. Write a paper about Florida's environment describing the changes caused by the energy "crisis."

8. Investigate the role of the U.S. Environmental Protection Agency in controlling environmental damage. (It is supposed to enforce regulations covering clean air, water, hazardous waste disposal, toxic substances, etc.)

9. Investigate the Chinese system of trading city wastes for rural farm products via railroads.

Title: A "Sunlit" Future?

Concept: The sun is the earth's principal source of radiant energy.

Objective: To understand the potential for the use of solar energy

Introducing the lesson:

1. Present this scenario:

   a. Dr. Harry E. Thomason heats his three-bedroom home near Washington, D.C., for $7 a year; he gets most of his heat free.

   b. Henry Matthews of Coos Bay, Oregon, built a solar heater for his six-room home for $1,000 and now pays less than $50 a year for supplementary fuel.

   c. 2,000 solar water heaters are being installed each year in Israel.

   d. there are 500,000 solar water heaters in Japan.

2. Ask: Is the United States turning to the sun as a prime source of heat and power? (No; there are only about 30,000 solar water heaters; only a few experimental solar power projects.)

Developing the lesson:

1. Investigate the extent of solar water heating in Florida. (Write to the Florida Solar Energy Center, Cape Canaveral.)

2. Compare present use in Florida with that 30 years ago. (In 1951, there were 50,000 solar water heaters in Miami alone, and several companies were making them; many are still in use today.)

3. Write to the Florida Solar Energy Center for information on new developments in the use of solar energy for cooling and heating.

4. How much radiant energy does the earth receive from the sun? (Even the small amount that reaches the earth equals the energy in 120 trillion tons of coal each year; more energy falls on the roof of an atomic reactor building than is generated inside the reactor; the Florida average is 625 BTU/sq. ft./hr.)

5. Discuss the advantages of solar energy.

   a. availability - everywhere except the polar regions during winter, in plentiful amounts and at predictable rates.

   b. clean, also cleansing.

c. not subject to import quotas or embargos or price manipulations.

d. supply can never be depleted.

e. generator will never need repairs.

6. So what is the problem? (How to convert this energy into more usable forms is the main problem.)

7. What has held back the development of solar power? (Power from oil, gas, and coal has been cheap, so work has been done only on small things - heaters, cookers, etc.; no money for research from the government or the energy companies; no great urgency to develop it.)

8. What changed this situation? (the fossil fuel shortage; and the success of the space solar cell experiments)

Extending the lesson:

1. Construct a small model solar water heater.

2. Better yet, devise a plant to heat all the water in your home or school with solar radiation.

3. What happens to solar power at night? (One of the big problems with solar power is how to store electricity for use at night when there is no solar radiation; in mountainous areas, water can be pumped up into a high reservoir during the daytime when power demand is low, and then the water can be released to flow down through turbines to produce power at night - called pumped storage.)

4. Can we rely entirely on solar power? (Many experts think we can. Van W. Bearingen of Honeywell Corporation says: "Technical breakthroughs are not needed - the means to convert solar energy to electricity are here today. The problem is an economic one.")

5. What are the economic problems Dr. Bearingen refers to? (lack of federal support for research and development of solar systems)

6. Investigate some of the proposals for use of the oceans as a source of solar power - waves, tides, thermal gradients, and ocean currents.

Title: Appropriate Technology

Concept: The sun is the source of the earth's radiant energy.

Objective: To understand the need for balancing our technology with available energy supplies

Introducing the lesson:

1. On April 27-30, 1978, the ACT (Appropriate Community Technology) Fair/Conference featured the development on the Mall in Washington, D.C., of a self-reliant, environmentally clean model community, the largest gathering of appropriate technology advocates ever held on the East Coast. The exhibits covered energy, agriculture, health, housing, transportation, communications, recreation, legal services, education, and community economic development.

2. List the kinds of exhibits. (Exhibits included an alcohol-producing facility, solar grain dryers, urban gardening, pest control, electric cars, a solar greenhouse, recycling systems, fish-rearing tanks, and low-cost urban solar applications.)

Developing the lesson:

1. From the scenario of the fair given above, ask the students to describe "appropriate technology." (small low-cost technology to meet the needs of a community or group, using available low-energy materials and methods which are more "appropriate" in the present energy situation)

2. In 1982, the Worlds Fair theme was "Energy Turns The World." Have someone who attended the Worlds Fair in Knoxville, Tennessee, describe the energy exhibits. Discuss the meaning of "Energy Turns The World."

3. Have a group of students read and report on the book, Small is Beautiful, by the British economist E. F. Schumacher, (Harper, Row, 1973), one of the originators of the concept.

4. Discuss Schumacher's key concept of energy: As long as there is enough primary energy, at tolerable prices, there is no reason to believe that bottlenecks in other primary materials (minerals, water, etc.) cannot be either broken or circumvented. On the other hand, a shortage of primary energy would mean that the demand for other primary products would be so curtailed that a question of shortage with regard to them would be unlikely to arise. (In short, with energy, we could use substitutes for iron, but without energy, there is no need for iron.)

5. Investigate the effects of the "Green Revolution" on primitive societies. (Effects are the opposite of appropriate technology, with disastrous results - introduction of hybrid seed, with the need for irrigation, fertilizers, pesticides, etc. to replace manpower in areas with nothing much except manpower.)

Extending the lesson:

1. Discuss the possibilities of urban and community gardening. (vacant lots, rooftops, school grounds, power line right-of-ways, etc.)

2. Investigate how to grow vegetables hydroponically.

3. Design a rooftop or campus garden or nursery for your school.

4. Design and build a solar water heater for your school, and calculate the savings in electricity use.

5. Discuss the philosophy of why tommorrow can be better with less.

6. Read and have a group of students report on Amory Lovin's book, Soft Energy Paths: Toward a Durable Peace. (Friends of the Earth International, 124 Spear Street, San Francisco, California 94105, 1977, paper, $3.95)

7. Draw a picture of you and a group of your friends practicing appropriate technology.

Title: Sun Gods

Concept: The sun is the source of the earth's radiant energy.

Objective: To help students understand the relationships between the sun and people

Introducing the lesson:

1. Read Shelley's "Hymn of Apollo":

   I am the eye with which the universe
   Beholds itself and knows itself divine;
   All harmony of instrument or verse,
   All prophecy, all medicine are mine,
   All light of art or nature; to my song
   Victory and praise in their own right belong.

2. Now read the "Hymn of the Vedas" (sages of India):

   And when the Sun arose they could not understand
   How the new-born God could wield such power.
   And they said: "Let us worship the Child of Sky.
   He stands up as a mighty flame,
   He stretches his arms,
   He is everywhere like the wind."

Developing the lesson:

1. Discuss how ancient peoples who did not have any knowledge of astronomy could consider the sun as a god.

2. Read in Chapter Two of Walden by Henry David Thoreau of how his feelings at sunrise were greatly influenced by the Vedic hymns. The Vedas say: "All intelligences awake with the morning. To him whose elastic and vigorous thought keeps pace with the sun, the day is a perpetual morning. It matters not what the clocks say."

3. Describe sunbursts coming through the trees in the early fog of morning.

4. Can you find sun gods in other cultures?

   a. Egyptian - King Akhnaton called Aton "the only Egyptian God":

      "When you sink down below the west, Our land becomes a land of the dead."

b. Papago Indians of southwestern United States - an excerpt from their "Sun Ceremony":

"In the East is the house of the Sun.
Up over the top of his roof beam
The Sun climbs and journeys
Over the heads of us
Who make our journey below him.
I stretch my right hand sunward,
Then trace upon my body
The ritual sign."

c. Greek - Sun God Zeus.

d. Roman - Sun God Apollo.

5. What about sun goddesses? (Japanese sun goddesses represented "good" in their battles with the storm god, "evil.")

Extending the lesson:

1. Create a skit showing the Japanese "battle" between the sun goddesses and the evil god of storms.

2. Find pictures of the Inca temples to the "Sun Father."

3. Trace sun gods in the cultures of the Seminole, Caloosa, and Sioux Indians.

4. Show modern worship of the "Sun God." (tourists)

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Title: Back To The Good Old Days?

Concept: People use energy to satisfy their needs.

Objective: To understand the relationship between people's use of energy and their lifestyles

Introducing the lesson:

1. Present the following scenario: Ah! The good old days. Five acres and independence. Let's get back to the land. Mother Earth and Nature's Way. A plow, a mule and forty acres, and a good woman are all any man needs. Organic gardening will save our land. Energy crunch - who cares? We'll garden and can, use candles for light, and heat with wood.

   These are popular phrases that you all have heard.

2. Ask the students for an initial reaction to the scenario.

Developing the lesson:

1. Investigate in detail the various uses of energy in the "good old days." Dr. Earl E. Gavett of the U.S. Department of Agriculture did a study to see what might happen if the United States decided to "go back." He compared 1918 and 1975, and found:

   a. If gas-guzzling tractors were laid aside, we would need 61 million horses, mules, and oxen to replace them; at present, we have only 3 million, and it would take 20 years of breeding to get to the 61 million mark.

   b. The 61 million animals would need the grain from half of United States cropland just for feed.

   c. To work the animals would require a work force of 30 million people; at present, about 4 million people work on farms; where would the other 26 million come from? (8 million from the unemployed, the rest from other work areas now paying double the farm wages)

   d. Other labor problems - city workers who move back to the farms - would be less productive until trained.

   e. There would be food supply problems:

      (1) animals would eat half of the food supply.

      (2) people overseas would starve without U.S. food.

2. Ask: What does this study mean? (The study indicates that we can't go back to the good old days from any standpoint - economic, labor supply, or world political. We must continue to use farm machinery.)

3. Discuss the effects of fueling farm machinery with alcohol or biogas. (The effect would be really the same as using animals - half our food would be used for tractors instead of for people and animals; without oil for gasoline, fertilizers, etc., the United States' agricultural system would break down.)

4. Discuss the effects of this scenario: Farmers produce 3 calories of food energy for every calorie of fuel they use. But, by the time the food is transported, processed, and packaged, then sold, 5 or 6 calories of fuel energy have been used for each calorie that reaches the table.

Extending the lesson:

1. Make comparisons similar to Dr. Gavett's study of agriculture for power and housing.

2. Ask: How can you practice energy conservation via food? (use fresh foods; do home canning at harvest time; avoid overpackaged foods; and eat less)

3. Discuss the will and ability of the American people to conserve energy.

4. Discuss whether the good old days were really that good.

Title: Energy Policy -- Or Non-Policy

Concept: People use energy to satisfy their needs.

Objective: To help students understand the need for regulation of energy use

Introducing the lesson:

1. On November 7, 1973, in response to the Arab Oil Embargo, President Nixon emphasized the need for United States' energy dependence at an early date, saying: "Let us set as our national goal that by the end of this decade (1980) we will have developed the potential to meet our own energy needs without depending on any foreign energy source." The decade has now ended, and three presidents later, no one even predicts energy independence. In fact, energy experts tell us that we will become increasingly dependent on foreign energy sources.

2. Ask: What happened?

Developing the lesson:

1. Investigate and discuss the need for a national energy policy. Consider:

   a. the need for energy is increasing.

   b. no guarantee that foreign oil will meet demand.

   c. no guarantee that foreign oil deliveries will continue.

   d. cost of foreign oil is economically disastrous.

   e. we have no policy or direction for a course of action to meet our short, intermediate, or long-term needs.

2. How do oil companies expect to increase domestic production? (offshore, Alaska, enhanced recovery, etc. - all terribly expensive and needing a profit motive for exploration)

3. Investigate how the Federal Energy Administration (now the Department of Energy) recommended that the nation reach energy independence in their report to President Ford in March 1976: "The National Energy Outlook." (decontrol prices; accelerate offshore leasing; open the naval petroleum reserves; lower environmental standards)

4. Discuss the difficulty of getting all of this done in the Congress. (Each recommendation is fought by a special interest group - consumers, environmentalists, energy company lobbyists, fishermen, etc.)

5. Do you think President Reagan's proposal to eliminate the Department of Energy is a good idea? Investigate the present federal policies toward energy.

6. Investigate the "windfall" profits tax on the oil companies.

7. Investigate what finished off "Project Independence." (The Energy Act of 1975 rolled back the price of crude oil, caused a 5 cent drop in the price of a gallon of gasoline; the public thought the energy crisis was over and went on another big car buying spree.)

8. Did the same thing happen in 1981-1982 when there was a so-called "glut" of gasoline on the market?

9. List the three requirements for the solution of our energy problems. (capital, time, and a unity of purpose; at this time, we have none of these)

Extending the lesson:

1. Discuss the need for conservation. (A 30 percent reduction in our energy use would be the same as finding a new 30 percent energy source.)

2. Discuss the reasons for the lack of a national "unity of purpose." (Are we selfish, greedy, spoiled, dishonest?)

3. Why are we short of time? (We have done little to solve our basic energy problems since the Arab Oil Embargo.)

4. Do we have the capital to finance the effort? (The people say it's time to balance the budget; the oil companies say: not with the windfall profits tax.)

5. While Washington was fiddling, many localities have been doing things about energy shortages. Investigate:

   a. Davis, California - U.S. News and World Report, September 3, 1979.

   b. Shenandoah, Georgia - solar power to run knitwear plant.

   c. Lawrence, Massachusetts - repaired old dam for electricity.

   d. Ames, Iowa - uses trash for power generation.

   e. Apalachicola, Florida - solar school.

Title: Energy And The Developing Nations

Concept: People use energy to supply their needs.

Objective: To understand the demands of developing nations for a larger share of the world's resources

Introducing the lesson:

1. Say: These days we hear a lot about the energy crisis and what is it doing to the American economy, people, and institutions. One of the overlooked consequences of the OPEC oil price increases has been the effect on the developing nations, who were just beginning to use high-energy machines, fertilizers, etc., to increase their food supplies and industry.

2. Discuss why the developing nations are demanding more energy. (for agriculture, food, transportation, desire for a higher standard of living)

Developing the lesson:

1. Discuss this statement by OECD (Organization for Economic Cooperation and Development, UN, Paris) official Maurice J. Williams (in Foreign Affairs, January, 1976): "Since non-oil developing nations are relatively small users of oil, accounting for only 10 percent of annual world consumption, OPEC countries underestimated the importance of oil to them and tended to regard forecasts of the dire effects of oil price increases as part of the publicity campaign by industrial consumers against higher prices."

2. Discuss why developing countries are hardest hit by oil price increases. (They must pay more for oil while they are suffering a serious decline in their export earnings during the ensuing depression. They, in turn, had to reduce their imports and borrow to finance their development.)

3. Where did the borrowed money come from? (Ironically, from OPEC deposits in world banks - Saudi Arabia has loaned 5% of their income from oil to other countries.)

4. Investigate the concern of world bankers that many of the developing nations may default on their loans, Time, March 3, 1980. (This debt is now over $350 billion. If a nation defaults, banks may fail, setting off a worldwide financial panic and bringing world trade to a halt, as happened during the Great Depression.)

5. What is the result of these banker fears? (Some nations can no longer borrow money.)

Extending the lesson:

1. Ask: Why did the developing nations at first endorse the use of the "oil weapon" by the OPEC nations in 1973? (It caused discomfort to the rich industrial nations; their leaders also believed the OPEC thesis that the oil price increase was "the vanguard of a new economic order which would benefit all developing nations" - quote from Department of State Publication 8863, July 1976.)

2. Have the OPEC nations done anything to help the developing nations? (Yes. They have made low interest loans, although they have refused to grant lower prices because the oil could be resold at higher prices.)

3. Design a campaign to promote World Bank and OPEC aid to the developing nations.

4. Compare the domestic and foreign policies of nations affected by the energy crisis.

5. Is oil a "weapon"? Discuss use of energy resources to accomplish national goals. (Iran, Israel, Egypt, United States)

6. Investigate the role of the OECD in helping to meet the energy demands of the developing nations.

Title: Who Limits Energy Supplies?

Concept: Many factors limit energy supplies.

Objective: To help students understand how social, political, and environmental factors tend to limit energy supplies

Introducing the lesson:

1. Read advertisements from various sources blaming the energy crisis on others. (energy companies, environmentalists, economists, etc.)

2. Ask: Who is responsible for limiting energy supplies? (Every energy user is responsible for making demands for energy which exceed the supplies, but everybody is blaming "the other fellow".)

Developing the lesson:

1. Investigate business-industry charges that environmentalists are limiting energy supply. Consider:

   a. strip-mining restrictions.

   b. Alaskan pipeline delays.

   c. nuclear power plant opposition.

   d. Clean Air and Clean Water Acts.

   e. offshore oil leasing.

   f. coastal refinery restrictions.

2. Investigate ways that governments limit energy supplies.

   a. Federal Power Commission.

   b. Nuclear Regulatory Commission.

   c. price controls.

   d. mine safety regulations.

   e. Clean Air and Clean Water Acts.

   f. National Environmental Protection Act (NEPA).

   g. lack of energy policy and direction.

   h. lack of support for solar research.

   i. lack of deep port facilities for supertankers.

3. Investigate charges that energy companies held back energy supplies to create shortages and raise prices.

   a. more oil became available after price was raised.

   b. gas shortage until price was decontrolled.

   c. planned shortages of heating oil.

   d. power plant brownouts.

   e. lack of support for solar energy they can't control.

   f. monopoly of energy sources to avoid competition.

4. Investigate "windfall" profits of oil companies.

5. Discuss whether or not the government is "overregulating" the energy industries. How did you decide?

Extending the lesson:

1. Investigate relaxation of pollution standards by the Florida government to allow use of higher-sulfur oil in electric power plants when oil supplies were limited.

2. Investigate the energy "cost" to the environment of power plants.

3. Investigate the energy cost of pollution control in:

   a. automobiles.

   b. electric power plants.

   c. factories.

4. Draw a cartoon placing the blame for limited energy supplies on some group.

5. Discuss wh, the United States faces an energy challenge.

6. What can you as an individual do about it?

7. Do it.

Title: Energy Crisis -- Leading To Conflict?

Concept: People compete for scarce resources.

Objective: To understand the dangers of competition among nations for limited energy supplies

Introducing the lesson:

1. Organize a class debate to argue the statement that energy shortage is leading to conflict, as it applies to people, states, and nations.

2. Read President Carter's Energy Message and State of the Union Message to the Congress for insight into our nation's policy regarding threats to United States' supplies of Persian Gulf oil.

Developing the lesson:

1. Investigate the present administration's policy regarding supplies of Persian Gulf Oil.

2. Discuss why oil is so important. (It is the largest international industry - the commodity which makes the wheels of our technological society go around.)

3. Discuss how the western industrial nations became so involved in the Middle East oil power game.

4. Ask: Is it too late for the oil-consuming nations to reduce their dependence on Middle East oil? (probably yes - at least for the time it takes to develop a solar energy capability.)

5. What are the stakes in the Middle East oil game? (about 25 million barrels of oil daily - enough to meet the growing demands of Western Europe, Japan, and the United States)

6. How did the oil game begin? (with the discovery of a 60-foot deep well in Titusville, Pennsylvania, in 1859 by Edwin L. Drake, and the subsequent replacement of coal as the primary energy source)

7. Investigate the work of John D. Rockefeller in selling oil.

8. Investigate the beginning of the first competition among United States oil companies. (The monopoly held by Rockefeller was broken by the U.S. Supreme Court, followed by the entry of Gulf, Mobil, Texaco, and Shell.)

9. Trace the influence of the automobile and airplane on oil industry competition. (stations along highways)

10. Investigate the massacre of Armenian oil workers by Tartars in 1905, and the sabotage of their fields and equipment.

11. Investigate the United States, French, and British struggle for control of Middle East oil following World War I. (The British took over the Turkish Petroleum Company; French took over Lebanon and Syria and a one-quarter interest in Iraq oil; while the United States became dominant in Saudi Arabia by backing Ibu Saud as the legitimate ruler.)

12. Trace the development of the United States' influence in Iran until the overthrow of the Shah in 1978.

13. Trace the development of the on-going crisis in the Middle East: Arab - Israel - United States.

14. Discuss whether governments, including our own, would be willing to go to war for Middle East oil.

15. Investigate how energy resources are being used to accomplish national goals. (United States, USSR, Mexico, Iran, Venezuela, Canada, Libya, Algeria, etc.)

16. Compare the domestic and foreign policies of nations affected by the energy crisis.

Extending the lesson:

1. Discuss how oil has changed the Middle East.

2. Investigate the resources fought for in the wars of the past.

3. Draw a comparison between Arab use of the oil weapon and United States' use of the food weapon by President Ford.

4. Find someone who has a definite bias regarding the energy crisis and who caused it.

5. Determine the basis for each bias encountered.

6. Now check yourself.

Title: A Four-Day Week?

Concept: People must conserve limited energy supplies.

Objective: To understand and evaluate possible methods of conserving limited energy supplies

Introducing the lesson:

1. Begin class with a fictitious announcement from the school principal:

   Effective next Monday, our school will operate on a four-day week in order to conserve energy.

   Later today, ballots will be distributed so you, the students, can decide on whether to have school closed on Mondays or Fridays. So think about it in your classes today.

Developing the lesson:

1. Before any discussion, take a vote on the Monday or Friday question.

2. Discuss the class vote and the reasons for their choice of the day to have off.

3. List the reasons for preferring each day.

4. Calculate the energy savings for the school. (One day = 20 percent of the school week.)

5. Discuss the effect on net energy use in the community. (Students out of school may use more energy than they use in school.)

6. Discuss the savings if school days were lengthened to make up the time lost on the day off. (Would have no effect on buses or kitchen; other utilities might have to be on longer.)

7. Describe the impact on:

   a. your home.

   b. your family.

   c. your community.

8. Consider the economic effects on school employees. (for example, salaries for four days instead of five for kitchen personnel)

Extending the lesson:

1. Consider the impact of a four-day week on United States society.

   Consider:

   a. transportation - commuters, etc.

   b. home use of electricity.

   c. business.

   d. industry.

   e. recreation and leisure-time activities.

2. Discuss the changes in lifestyles which might result from a four-day week. (People may travel more with three-day weekends.)

3. Discuss additional energy conservation measures your school might undertake.

4. Survey community reaction to a four-day work week. (Labor unions have been advocating a four-day work week for many years.)

5. Start a school energy conservation program.

6. Organize an energy awareness week for your community.

7. Design billboards, posters, and T-shirts to advertise your community energy awareness week.

Title: Energy And Society

Concept: Energy supplies determine social conditions.

Objective: To understand the relationship between energy use and patterns of society

Introducing the lesson:

1. Ask: Would you be surprised to learn that the "real" energy crisis on earth involves firewood, not gasoline, and that trees, not crude oil, are the world's most important endangered resource?

2. Discuss how this could be true.

Developing the lesson:

1. Why does Erik Eckholm of Worldwatch Institute believe that forests are more important to the world's future than oil? (They serve as the principal cooking and heating fuel source in Africa, Asia, and Latin America; they also serve to modify wind, temperature, humidity, and soil, as well as to recycle water, oxygen, carbon, and nitrogen. At present rates of deforestation, there is concern for their future as an energy supply.)

2. Desertification is a process whereby man's actions help turn forests into deserts. Identify some area of the earth that has experienced desertification. What does it have to do with forests and firewood?

3. What is happening to the forests? (They are being cut for firewood and lumber; eliminated for housing and industrial development.)

4. What is the alternative? (Kerosene, from crude oil, is a possibility, but price is too high for many, so they cut down the forests.)

5. Investigate use of firewood in Florida homes and wood wastes in Florida industries. (More wood is being used each year since the oil crisis.)

6. Investigate potential of Florida forests as a fuel source. (Uses as a fuel source are limited. Forests are now used for pulpwood harvesting, housing, and replaced by agriculture. Florida forests yield about 2.5 tons per acre per year. How many acres of forest would it take to feed a 500 MW electric plant? One lb of coal = 1 KWH of electricity. Wood has one-half the BTU value of coal.)

7. List the effects of the energy crisis on American society.

8. Investigate the effects of coal mining activities on small towns in the western United States. (Montana, Wyoming, Utah boom towns)

9. Compare the effects of the present energy situation in urban, suburban, and rural areas.

10. Check the validity of this statement: Energy shortages cause changes in societies.

11. Support your reasoning.

Extending the lesson:

1. Show how living things and environments are affected by shortages of energy.

2. Discuss how energy shortages are related to lifestyles and values.

3. Investigate changes in your community as a result of the energy crisis.

4. Discuss the effects of banning night athletic contests in Florida; in the United States. (Loss of recreation and entertainment; economic consequences, etc.)

5. Survey the effects of lowered lighting levels for signs, streets, highways. (crime, accidents, etc.)

6. Survey local businesses to determine possible effects of banning billboard lighting.

7. Report your results to the Chamber of Commerce.

8. Discuss the environmental effects of an energy crisis in your community. (use of high-sulfur fuel for power plants, relaxed environmental standards, etc.)

Title: Energy And The Environment On A Collision Course

Concept: Energy use affects environmental quality.

Objective: To understand the relationship between energy use and environmental quality

Introducing the lesson:

1. In 1972, the Administrator of the U.S. Environmental Protection Agency, said: "The problem of energy and the environment is a difficult one indeed. At the moment the two are on a collision course."

2. Ask: What did this statement mean? (All available fuels we have to produce the energy we need result in an environmental negative.)

Developing the lesson:

1. List the "environmental negatives" of:

   a. nuclear fuels - radiation and heat.

   b. coal - strip mines, acid waste, air pollution.

   c. oil - well blowouts, tanker spills, air pollution.

   d. water power - damming of rivers.

2. Why not avoid the collision? (We do not yet have a non-polluting option; for the time being, we have to use coal, oil, and nuclear.)

3. Investigate how clean air and water regulations of the Environmental Protection Agency and the Florida Department of Environmental Regulation have affected energy use.

4. Investigate the Reagan Administration's proposals to by-pass environmental constraints.

5. Review the activities of the anti-nuclear lobby. (Twelfth Grade, Unit II, Lesson 3)

6. Investigate the costs of pollution to society in terms of:

   a. health.

   b. lost productivity.

   c. damage to crops and materials. (total estimated at $16 billion a year)

7. Discuss water pollution costs in Florida in terms of:

   a. recreation.

   b. commercial fishing.

   c. agriculture.

   d. drinking water quality.

8. Investigate fuel costs of emission control devices on automobiles. (estimated 5-8 percent loss in mileage)

9. Investigate the environmental problems of various energy supply sources - Alaska, North Sea, Gulf of Mexico, Channel Islands, California, Appalachia, Montana, Persian Gulf.

Extending the lesson:

1. Predict the effects of future energy supply sources on the environment.

2. Discuss our ability to have both energy and a clean environment.

3. Ask: Will the United States agree to international controls to protect the global environment? (Consider the United Nations Conference on the Human Environment; Law of the Sea Treaty.)

4. Discuss energy-environment problems in Florida. (air and water pollution by power plants, agriculture, and industry; automobile use, etc.)

5. Investigate environmental effects of alternative fuels - geothermal, fusion, solar, ocean thermal gradients, etc. (Not much is known about these costs.)

6. Investigate the environmental effects of alcohol production from crop residues and grain.

Title: Lessons Of The Fuel Crisis

Concept: Energy use affects societies.

Objective: To understand the relationship between energy use and society

Introducing the lesson:

1. Say: According to C. C. Garvin, Jr., Chairman of Exxon Corporation, there is mounting evidence of what has been referred to as a "new complacency" about energy problems among consumers.

2. Discuss the reasons for Mr. Garvin's concern. (Oil resources are being consumed faster than new discoveries of oil are being made, and no other forms of energy are yet ready to fill the gap.)

Developing the lesson:

1. Discuss student reaction to Mr. Garvin's statement.

2. Survey student evidence of complacency about the energy situation.

3. Ask: What is the alternative? What have we learned? (Hopefully, we have learned that the only immediate answer is energy conservation to reduce the rate of increase in world energy consumption.)

4. Discuss the validity of this statement: When a price soars, oil is often the reason. (Consider the prices of gasoline, plastics, fertilizers, clothing, chemicals.)

5. What have we learned about the interdependence of nations of the world? (need for global consultation and cooperation to avoid conflict and hardship)

Extending the lesson:

1. Discuss the possibility of supporting the world's population with natural products. (impossible - not enough trees, soil, cotton, fertilizer, etc.)

2. Survey stores and fast-food restaurants for examples of plastic packaging that is not necessary.

3. Look for clothing and shoes made from natural materials. (It is very hard to find all cotton, silk, wool, leather products.)

4. Ask the students to discuss what they have learned from the energy crisis.

5. Start an energy conservation program to help your community "learn" from the energy crisis.

ENERGY AND MY ENVIRONMENT

SUPPLEMENTAL ACTIVITIES

FOR

GRADE ELEVEN AND GRADE TWELVE

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Title: Supply Costs

Purpose: To develop an understanding of some of the factors that contribute to the cost of fuel

Materials: Map of Florida that indicates harbors, population centers, environmentally sensitive areas, and current land uses, roads and railroads

Procedure:

1. Review where crude oil supplies originate in Florida, in the U.S., and in other countries.

2. Say: Building an oil refinery is an expensive and complicated undertaking. At this time there are no refineries in Florida. The nearest refinery is located in Louisiana.

3. In order to understand an important part of the problem of the high costs involved in selecting a suitable site and building a refinery in Florida, some of the things which must be considered are:

   a. a deep water port is necessary

   b. adequate overland transportation must be available or constructed (roads, railroads)

   c. a labor force (union involvement) must be available

   d. the possibility of destroying environmentally sensitive areas

   e. state and national laws and regulations

   f. local restrictions/ordinances

   g. present use of land. (agriculture, housing, maritime operations, recreation)

4. On the map of Florida try to locate a site most suitable for locating a petroleum refinery.

5. How would the distance (or nearness) of your selected site impact on your community?

6. Would the distance (or nearness) of a refinery built at your selected site affect the cost of energy to you? (Usually, the nearer the refinery the less you pay for the product; the transportation costs would be less.)

7. Decide (or dicuss) if a refinery would be a good thing for all the people of Florida.

Title: Energy Use In Florida

Purpose: To show that energy conservation is not for "others" and how simple a plan is to implement

Procedure:

1. Divide the class into committees - possibly 5 or 6 to a committee.
2. Have each committee survey the entire school plant for:
   a. procedures that waste energy,
   b. inefficient equipment,
   c. lighting,
   d. physical plant design.
3. Have each committee report to the class their findings.
4. As a class, set up two lists:
   a. those things we can do something about,
   b. those that the principal needs to do something about.
5. Design and implement a plan that includes those areas that you can correct or help.
6. Write a letter to the principal suggesting what he needs to do to correct the other areas that are energy wasters.

Title: New Fossil Fuels

Purpose: To show that the problems (costs) of producing synfuels are much more than simply concentrating the energy

Procedure:

1. Research how much shale has to be processed to produce a barrel of oil.
2. Find out how much water is needed to produce a barrel of oil.
3. How is the oil to be moved from the production area? Does a system now exist in most areas of shale?
4. How will the land be reclaimed and who will pay for it?
5. What residues are produced as by-products in the various processes? What will be done with them?
6. Try to paint a realistic picture of the total Cost of producing usable energy from this fossil fuel deposit(s).
7. Discuss "net energy." (Net energy is the amount of energy left after you subtract the amount of energy used to mine and extract the oil from the shale.

ENERGY POTENTIAL OF EXTRACTED OIL

\- ENERGY USED TO MINE AND EXTRACT THE OIL

= NET ENERGY

GRADE 11, UNIT II, LESSON 1

Title: The Farmer As An Energy Producer

Purpose: To show that much of our food costs are not for the cost of foodstuffs

Procedure:

1. Have each student list 10 of their favorite foods.
2. Have them locate where each food was produced and how it came to his/her home. (region of the country where grown, how it was harvested, stored and shipped)
3. Indicate how each was packaged and sold.
4. Tell how each food was prepared for eating. (eaten in purchased form or further processed)
5. Finally, have each student summarize those factors that have contributed to the cost of their "food bill."

GRADE 11, UNIT II, LESSON 2

Title: Transportation 2000

Purpose: To determine the most efficient method of transportation

Materials: Newspaper ads and travel brochures

Procedure:

1. Make a chart indicating a compact car, mid-size car, a luxury-sized car, a bus, and an airplane. On the chart have a column indicating the operating cost per mile per person.
2. Gather information about the miles per gallon and the number of recommended passengers per car from ads.
3. Find the cost for bus and plane fares to various destinations, as well as the number of passengers that can be transported.
4. Using the current gasoline (gas, diesel, kerosene) prices, determine the price for each passenger mile.
5. Determine which form of transportation might be best used in your travels.

Title: Transportation 2000

Purpose: To determine the energy required to transport students to school

Procedure:

1. Review with students general concepts in the natural production of fossil fuels. Direct the discussion to petroleum specifically. Have students determine what volume of crude oil is necessary for the production of a gallon of gasoline.

2. Discuss with the students the need for transportation. Have students list the various modes of transportation. Direct student discussion to school bus transportation.

3. Have a student call the school bus garage to find out the number of buses operating at the high school. Also find out the miles driven by the buses per day and the average number of miles per gallon. Calculate the number of gallons of gas consumed by the buses per year.

4. Have several students count the number of student cars in the parking lot. Calculate the average number of miles driven by students to and from school.

   a. Calculate the gallons of gasoline that could be saved (annually) if all the students who drove cars rode buses instead.

   b. Calculate the gallons of gasoline per student (annually), including fuel consumed by buses and by student's automobiles.

5. Students should then break up into small groups to determine the most efficient mode of transportation. They should discuss reasons why the most efficient method is or is not used. Discuss:

   a. If the most efficient consumption of fuel is not being used, what impact is this on local social standing and on environmental damage?

   b. What suggestions do you have for more efficient use of this fossil fuel?

   c. In the event of another fuel shortage, what could be done by students to conserve fuel?

GRADE 11, UNIT II, LESSON 3

Title: Nuclear Energy

Purpose: To determine if nuclear energy should be used

Materials: Newspapers, magazines and resource books

Procedure:

1. Review the nuclear issue and problems such as the Three Mile Island incident, the Diablo Canyon controversy, storage of wastes, etc.

2. Have each student list the electrical appliances in their home. Check those you would give up to avoid having a nuclear power plant in your community.

3. Discuss the concern over the depletion of fossil fuels in the relative near future.

4. Have each student write a report on, "What I would be willing to give up so we won't need a nuclear power plant in my community."

GRADE 11, UNIT II, LESSON 3

Title: Nuclear Energy

Purpose: To demonstrate the ability of radioactive material to permeate living things

Procedure:

1. Say: Presently, most of our energy requirements are met through using fossil fuels. However, there are other alternative sources of energy such as solar, wind, fission, fusion, hydrogen, hydro, and geothermal which must be considered and developed.

2. Obtain radioactive isotopes suitable to use as tracer elements. Introduce the radioactive material to the soil of a plant. Have students determine the radiation by using a Geiger counter. After one hour, have students count the frequency of clicks. (Background radiation should be determined first and then the plant's frequency.) Students should continue to measure the radiation until it approximates background radiation. Have the students keep a record of the frequency of clicks and the duration involved.

3. Discuss the problems with radiation artificially added to the environment and the sources of that radiation.

GRADE 11, UNIT III, LESSON 1

Title: Energy Transfer In Natural Systems

Purpose: To show that the energy directly used by an automobile is only part of total energy needs of a car

Procedure:

1. Identify the more common needs of keeping a car operating - gas, oil, tires, batteries, etc.

2. Trace the processes requiring energy needed to produce these items and transport them to your local dealer.

3. To enlarge on the energy costs to produce a car, you could review mining, transporting the ore, processing the steel, and the manufacturing process.

4. Discuss what it "really" costs to keep a car in operation.

GRADE 11, UNIT III, LESSON 2

Title: A Slice Of Toast

Activity: Decide whether our basic way of life in this country is very "basic"

Purpose: To recognize what is essential and what are luxuries

Procedure:

1. Discuss how other societies live and communicate. (size of homes, use of bicycle, mass transportation, etc.)

2. Identify what essentials are necessary for us to live and to be comfortable. (shelter, food, clothing, human interaction, etc.)

3. Have each student prepare a short speech on "What is basic to me."

GRADE 11, UNIT III, LESSON 2

Title: A Slice Of Toast

Purpose: To examine attitudes toward lowered speed limits

Procedure:

1. Say: Speed requires energy. Most automobiles operate much more efficiently at 50 MPH than at 70 MPH. As an energy conservation measure, the U.S. government in 1973 lowered the speed limit on the interstate highway system from 65 to 55 MPH. Daily experience of persons driving along the interstate system verifies that the 55 MPH limit is violated by enormous numbers of drivers. An increasing use of citizen band radios by truck drivers and some motorists appears to be a deliberate attempt to foil the police in their efforts to enforce the lowered speed limits.

2. Ask each member of the class to interview two or three licensed drivers asking a series of question such as:

   a. How serously do you regard the 55 MPH limit?
   b. How seriously, in your judgment, do other drivers appear to regard it?
   c. Do you think it was a good idea to try to slow down traffic to save energy?
   d. Do you think it is o.k. to use the CB radios to "beat the police"?

3. Pool and discuss findings in a class setting. Share conclusions in a class developed "letter to the editor."

GRADE 11, UNIT III, LESSON 2

Title: A Slice Of Toast

Purpose: To examine the importance of energy in a specific vocational field

Procedure:

1. During a social studies unit on choosing a vocation, or at some other appropriate time, ask students, working alone or in pairs, to develop a notebook on an occupation of their choice.

2. Specify that in addition to availability of work in the vocational field, salary potential, education required, special training needed and so forth, special attention be given to the energy requirements associated with their vocational choice. How would their vocation be affected if special forms of energy such as natural gas would be curtailed drastically? What would be the effect if gasoline prices doubled? If electricity became much more expensive?

3. Ask that students consider the ecological impact of their occupation on the local community, state, nation, and the world. Is the occupation likely to have a positive, neutral or negative effect?

Title: Energy And Food -- A Losing Proposition

Purpose: To compare the diets of Americans in 1940 with 1980 to show why more energy is used now

Materials: Food labels with contents indicated.

Procedure:

1. Discuss the different eating habits of Americans today as compared to the 1940 American. (more processed foods, instant foods, vitamins, quick food stores, etc.)

2. Compare methods of food production. (Compare today's use of insecticides, cultivation, irrigating, packaging, transporting and storing as compared to the labor intensive farming of the 1940's.)

3. From food labels, note all the food coloring, perservatives, flavor enhancers, vitamin enriched, etc.

4. Compare today's foods with those of 40 years ago as to the quality of what is eaten and as to the energy necessary to produce it.

Title: Energy And Food -- A Loosing Proposition

Purpose: To have students make personal choices about the "good life" and explain why they make certain consumer choices

Materials: Copies of THE EXPONENTIAL ENERGY CENTURY - GROWTH AND THE QUALITY OF LIFE (on following pages)

Teacher Information: This lesson begins with a discussion on the future of the United States. The list of items bought by each family of your students forms the basis of a survey. They use this survey as the starter for a class discussion. The discussion focuses on the relationship between the energy crisis and personal values about consumption.

Procedure:

1. Before copies of THE EXPONENTIAL ENERGY CENTURY - GROWTH AND THE QUALITY OF LIFE are given to the students, explain that it is not required that they fill in the blanks, nor is the survey to be considered for a grade. Begin by finding out what consumer choices have already been made. The survey is to be used to help move a discussion about choices forward, which will be in general terms only. If students have difficulty filling out the survey, you might ask them to complete it at home.

2. After students complete the survey, ask them to make a class list of items essential to living the "good life." You may anticipate disagreement on many of the items and lively debate. Then ask: Can you suggest ways to maintain a good standard of living, and yet reduce the number of items you would need? (Accept all suggestions.)

3. Ask: To what extent is your definition of a good life connected to using energy? Which items on the list depend on using fossil fuels to generate the electricity they use? (Have students mark each with a jagged mark like lightning.)

4. Have students count the marks. Ask: How many of the items you listed as "necessary for the good life" consume fossil fuel energy?

THE EXPONENTIAL ENERGY CENTURY - GROWTH AND THE QUALITY OF LIFE

NAME OF ITEM	1 Number of each item you have in your home	2 Check if item was in your house at the time you were born	3 Check if item was available when your oldest parent or guardian was born	4 Check if this item is considered a necessity by your family	5 Place an "O" if this item is considered a luxury by your family	6 Check if you think the item is necessary for you to live the "good life"
power lawnmower						
battery operated sphygmomanometer						
automobile						
motorcycle						
flush toilet						
snowmobile						
power boat						
C.B. Radio						
Electric:						
coffee maker						
skillet						
mixer						
toaster						
toaster oven						
microwave oven						
food processor						
potato peeler						
toothbrush						
shaver						
hot dog cooker						
grill						
rotisserie						
wok						
egg poacher						
steamer						

	1	2	3	4	5	6
Electric:						
fondue pot						
popcorn popper						
yogurt maker						
crepe maker						
tennis ball return						
cookie gun						
vibrator						
whirlpool						
heated swimming pool						
apple corer						
self-cleaning oven						
refrigerator						
freezer						
garbage disposal						
clothes washer						
clothes dryer						
water softener						
hair dryer						
food grinder						
bottle sterilizer						
baby food dish						
hamburger cooker						
saw						
hot plate						
ice cream maker						
waffle iron						
juicer						
teakettle						
knife sharpener						
movie projector						
leaf sweeper						
hedge trimmer						
meat slicer						
night light						
grass clippers						

	1	2	3	4	5	6
Electric:						
typewriter						
plant lights						
shoe polisher						
rake						
car washer						
insect sprayer						
roaster						
hair curlers						
rotating TV antenna						
floor polisher						
sandwich grill						
sauna heater						
scissors						
rug shampooer						
can opener						
slow cooker						
plastic bag sealer						
cooler						
knife						
fan						
compost shredder						
water heater						
mixer						
iron						
garage door opener						
curling iron						
deep fryer						
humidifier						
dehumidifier						
dictating machine						
dishwasher						
lawn edger						
curtain rods						
bun warmer						
dutch oven						

	1	2	3	4	5	6
Electric:						
organ						
piano						
doorbell						
skin machine						
radio						
clock						
griddle						
meat grinder						
tape deck						
stereo						
black & white TV						
color TV						
whirlpool bath						
socks						
handwarmer						
bed springs						
sander						
engine heater						
food dehydrator						
wall paper steamer						
baby food warmer						
train						
telephone						
furnace						
sewing machine						
calculator						
vacuum cleaner						
lawn clippers						
drill						
blanket						
freezer						
guitar						
telephone answering system						
timer						
dental hygiene set						

1 2 3 4 5 6

Electric:
welder
attic ventilator
back massager
golf cart
air conditioner
bread mixer
broiler
sunlamp
garbage compactor

(OTHER ITEMS?)

GRADE 11, UNIT IV, LESSON 1

Title: "Sunshine" (PREPARING FOR "SUN DAY")

Purpose: To show some uses and advantages of solar energy

Materials: Dependent upon plans

Procedure:

1. Write to the Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FLorida 32920 and request information about Sun Day - May 3.
2. Design and build solar hot dog cookers, ovens, water heaters, windmills, methane generators, alcohol stills, etc.
3. Prepare newspaper articles to inform the public about solar energy.
4. Have an open house to display projects.
5. Study solar-voltaic cells.
6. Invite guest speakers that are involved in solar energy to give presentations to the class.

GRADE 11, UNIT IV, LESSON 2

Title: Solar Cells

Purpose: To show alternate methods of producing electricity

Procedure:

1. Plan a field trip to visit an industry that uses solar cells or to a building that is equipped with a solar array
2. Write to telephone companies inquiring about their involvement in solar energy.
3. Write to local and state colleges/universities requesting information about their research in solar energy.
4. Request information from the Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, Florida 32920 concerning their research with using solar cells for heating and cooling.

Title: A Hydrogen Economy

Purpose: To review why hydrogen has not received public acceptance as an energy source

Materials: Resource materials from the Department of Energy and public utilities.

Procedure:

1. Review public disasters involving hydrogen gas. (Hindenburg Zepplin, 1937)

2. Study where hydrogen gas is being used in industry. (e.g., being used to check welding on seams of pipes)

3. Review production of hydrogen gas by electrolysis.

4. Review the feasibility of transporting hydrogen gas using current natural gas pipelines.

5. Analyze this statement:

   Just as we have designed apparatus and procedures to enable us to fill our automobile tanks with gasoline and carry the resulting 20 gallon "fire-bomb" at high speeds along a crowded highway and park it overnight inside our home, we can surely devise safe practices for handling hydrogen.

   This statement was published in the January 1973 Scientific American as part of an article by Dr. Derek Gregory.

Title: The Age-Old Struggle For Power

Purpose: To understand the difficulties involved in selecting a new energy source

Procedure:

1. Tell each student that he/she is a scientific developer and the fossil fuel supply is dwindling quickly. Coal may be used until another source is found.

2. The student's job is to find another feasible source of energy whether it be:

   a. fuels from plants,
   b. fuels from wastes,
   c. wind power,
   d. solar power,
   e. solar sea power,
   f. geothermal power,
   g. breeder reactors,
   h. or nuclear fusion.

3. Have the students consider:

   a. resources for the new source of energy,

   b. the technology needed to develop the source,

   c. if the new source is economically feasible,

   d. the environment effects.

Title: The Age-Old Struggle For Power

Purpose: To explore the effects of using vast amounts of fossil fuels to produce the things people want and need

Objectives: Students should be able to:

1. Explain the difference between a want and a need; a luxury and a necessity.

2. Discuss the realities of the world-wide energy problem.

Materials: Copies of THOSE BILLIONS ARE INDIVIDUALS (on following page)

Procedure:

1. Write the words needs and wants on the board.

2. Ask students to list as many things as they can, as fast as they can, under each category. (You may expect large and noisy disagreements to arise. If so, point out that the differences between wants and needs do become muddled at times. To a suburbanite a car may be considered a necessity. Two or three cars are probably luxuries - things people want - but do not have to have to survive.

3. Then ask students to follow the instructions on the student handout, THOSE BILLIONS ARE INDIVIDUALS

4. Complete the list.

5. Then discuss the proposition that, on the whole, Americans have benefitted from the use of large supplies of non-renewable fossil fuels. During the discussion, you may wish to raise the question of whether these same benefits will be as apparent in the future.

6. Ask:

   a. Does society need all they think they need?
   b. Will needs continue to grow and grow?
   c. What might stop the increasing list of "needs"? Why?

7. Have students write a paper entitled "How I Think The Shortage Of Energy Will Eventually Change My Lifestyle."

THOSE BILLIONS ARE INDIVIDUALS

1. Draw a line lengthwise down a sheet of paper.

2. On the left side, list the basic needs of every human being; water, food, clothing, shelter, etc.

3. On the right, list the things you need or want for your own lifestyle: color-TV, stereo, car, hot water, _____'s hamburgers, etc. Next to each item, name some of the resources of products needed to support these things: oil, electricity, iron, pesticides, grain, water.

4. Cross off 3 of the items on the right side so that people who lack the basic necessities on the left side can have them.

5. Cross off 3 more, since continued population growth and development will mean giving up such levels of consumption.

6. How many more items, if any, are you willing to cross off your list to sustain population growth as well as rising consumption in the U.S. and the rest of the world.

7. What values, if any, are in conflict?

Basic Necessities	My Needs or Wants
food	stereo (wood, oil, electricity)
water	T.V. (metal, oil, electricity, glass)
clothing	_____'s hamburgers (grain, pesti-
shelter	sides, fertilizer, oil, wood)
...	hot water (water, oil or gas, copper, lead
...	iron)
...	baggies (water, oil, wood)

Title: The Age-Old Struggle For Power

Purpose: To investigate alternative methods of distributing energy sources.

Objectives: Students should be able to:

1. List alternative methods of distributing global energy resources.
2. Identify the methods of distribution that are currently in practice and suggest reasons for each method.
3. Identify the global inequities of energy resource distribution.
4. State that distributing energy resources equitably is complex and difficult.

Materials: hungry students, one small pizza (6"), (Optional: 9 paper bags, felt pens)

Procedure:

1. Say: We will use a pizza to examine the inequities in the distribution of energy resources on a global (classroom) level. We will discuss alternative methods of distribution as we wrestle with the issue of how to slice the pie.
2. Write this question on the board: How should energy resources be distributed?
3. At the teacher's discretion, this activity can be introduced in several ways:

   a. Dramatic Presentation:

      - Have students draw faces on 10 paper bags.
      - Place a small pizza on someone's desk.
      - Write the ten methods for distributing the pizza (next page) on separate pieces of paper and put one method in each of the ten paper bags.
      - Have 10 students act as spokespersons or "candidates" for his/her method to try to convince everyone that his/her proposal for distributing the pizza is the best method.
      - Give each "candidate" a limited time to give his/her presentation.
      - Conclude by relating the methods proposed for the distribution of the pizza to distribution of the World's energy supplies.

   b. A second method is to list the proposals given below on the board with the question: How should golbal energy resources be allocated?

4. Regardless of the method chosen, students are to pick an alternative for distribution of global energy resources. This can be an individual task during which students "vote" for a candidate (proposal) of their choice. Or teachers may choose to divide class into small groups to promote student interaction.

Note: Watch out!! Some students may become frustrated waiting for their share. Some have stolen the food supply and actually taken a bite out of the pizza in full view of other classmates. If this occurs, the implications for discussion are many. How long can developing nations wait for answers to questions of energy distribution?

Methods for distributing the pizza include:

1. Sell to the highest bidder.
2. Divide it equally.
3. Save it for a rainy day.
4. Give to the people with the highest grades.
5. Award to the people who have worked the hardest in the class.
6. Give to the neediest people.
7. Award to the people who have contributed the most in class.
8. "First come, first serve."
9. Give it to the student whose desk it is on.
10. Give it to the strongest.

CONCLUDING THE LESSON: Ask students:

1. Given the state of world energy supplies, which proposal(s) do you think are totally impossible. Why?

   (Possible student responses: If resources were divided equally, no one nation would get the energy it needs; it's too late, the rainy day has arrived.)

2. Given the state of world energy supplies, which proposal(s) do you think explain our current global energy situation? Defend your answers.

   (Possible student responses: #1) Obvious, OPEC's price tactics; #4) Depending on students perceptions "high grades" may be interpreted as "high technology."; #5) Other students may interpret our high technology as "hard work"; #6) Foreign aid and investments will probably be seen as our contributions, providing one rationale for consumptive patterns among developed nations; #7) Since we've already developed, we're first in line; #8) Using the Middle East as an example, students can probably justify this proposal.)

3. Given the state of world energy supplies, which proposals would be the most difficult to implement? Defend your answers.

   (Student responses will vary. Reaching consensus on criteria such as "high grades," "hard workers," "neediest" and "contributors" is a difficult task.)

4. Which method(s) of distribution seem the most equitable? Which seem the least equitable?

   (Responses will vary. Students should cite their reasons.)

5. Could some methods lead to conflict?

   (Most could -- have students support their responses.)

EXTENDING THE LESSON

1. As a research project have students obtain the data necessary to translate the "pizza" into a circle graph illustrating consumption patterns among world areas.

2. Have students become "campaign managers" urging support for candidates representing each proposal.

3. Set up a role-reversal. How would a Nigerian, Indian or Brazilian student respond to each proposal?

4. Allow students to select and prove how one or two of the proposals are in practice today. This option requires further research.

5. In many ways, each proposal in this activity represents a different ideology. Students who have some background in comparative governments might enjoy trying to identify the best examples of the following economic systems:

   Communism (command economy)--Divide it equally;
   Capitalism (market economy)--Sell to the highest bidder, or first come, first serve.

Title: Mileage

Purpose: To help students become aware of alternate transportation systems as opposed to the "dream" machine

Materials: Copies of YOUR DREAM MACHINE (on following page) and latest EPA mileage charts from a local automobile dealer.

Procedure:

1. Begin the lesson with this assumption: Suppose you could buy any new car or van you like. Money is no object. What kind would you pick? What features on an auto are the most important to you?

2. List on chalkboard the general features suggested by students; topics such as:

   paint job
   sporty design,
   whitewalls
   air conditioning,
   good gas mileage,
   powerful engine,
   convertible,
   big size,
   four-speed transmission,
   designer interiors,
   vinyl top, or
   engine reliability.

3. Pointing to each feature in turn, ask: How many of you think this feature is important? Take count, then proceed to next feature.

4. Ask the students to again think of his/her "dream" car.

5. Distribute the dream car chart and have students find their "dream" car. (If they cannot find it, have them choose a car from the list that is a good second choice.)

6. Ask: Why did you pick this car?

7. Ask: What is the gas mileage rate of your car? How much would gasoline cost you each week for your car if gasoline costs $1.25 per gallon, and you travel 250 miles a week? Can you afford your dream car?

8. Compare the MPG information (1977) with the current information given on the latest EPA mileage chart.

9. Use this opportunity to introduce students to mass transportation systems.

YOUR DREAM MACHINE

Model	Manufacturer	MPG
Chevette	GM-Chevrolet	36
Civic CVCC	Honda	44
Corolla Sedan	Toyota	32
Datsun 200SX	Nissan	42
Accord CVCC	Honda	42
Celica GT	Toyota	26
Rabbit (gasoline)	Volkswagen	34
Fiat 128	Fiat	27
VW Station Wagon	Volkswagen	28
Opel (Isuzu)	Isuzu	27
Vega	GM-Chevrolet	28
Dodge Colt	Mitsubishi	35
Pinto	Ford	30
Mazda GLC	Toyo Kogyo	38
Mustang II	Ford	26
Datsun 280Z	Nissan	21
Volvo 244	Volvo	22
Gremlin	American Motors	23
Maverick	Ford	24
Volare	Chyrsler-Plymouth	20
Nova	GM-Chevrolet	17
GTO	GM-Pontiac	17
Trans Am	GM-Pontiac	17
Matador	American Motors	15
Cutlass Supreme	GM-Oldsmobile	18
Cougar	Ford	16
Ford	Ford	15
Buick Electra 225	GM-Buick	18
Plymouth	Chrysler-Plymouth	15
Silver Shadow	Rolls Royce	12
Chrysler	Chrysler-Plymouth	13
Bonneville	GM-Pontiac	17
Eldorado	GM-Cadillac	14
Buick Wagon	GM-Buick	18
Ford Wagon	Ford	13
Chrysler Wagon	Chrysler-Plymouth	12
Continental Mark V	Ford	13
Toranado	GM-Oldsmobile	15
Grand Prix	GM-Pontiac	17
Thunderbird	Ford	17
Mercedes 280 SE	Dailler-Benz	16
Seville	GM-Cadillac	16
Chevy Van V-8	GM-Chevrolet	18
Dodge Van V-8	Chrysler-Dodge	16
Ford Van V-8	Ford	16
VW Bus	Volkswagen	23

* January 1977 Gas Mileage from EPA City/Highway Test Cycle.

Title: "The Americar' Way"

Purpose: To help students understand the importance of getting there efficiently, economically, and reasonably

Materials: Transparency or copies of GETTING THERE (on following page)

Procedure:

After discussing the information included in the Getting There Chart, have each student design his/her transport of the future.

Table 1

TYPES OF URBAN TRANSPORTATION	FUEL MILEAGE (AVERAGE) (MPG = Miles Per Gallon)
Automobile	18 MPG
Van	16 MPG
Bus	3.3 MPG
Commuter Train	.1 MPG
DC Jet	.26 MPG

Table II

Forms of Transportation	Number of People	MPG	Fuel Needed for 20 Mile Trip (In Gallons)	Fuel Per Person (PMPG)
Car	1	18	1.11	1.11
Car	2	18	1.11	.56
Car	4	18	1.11	.28
Van	1	16	1.25	1.25
Van	2	16	1.25	.630
Van	8	16	1.25	.165
Bus	5	3.3	6.1	1.2
Bus	20	3.3	6.1	.31
Bus	40	3.3	6.1	.15
Train	1,000	.1	200	.20
Airplane	100	.25	80	.80

Remember: Passenger miles per gallon is arrived at by dividing the number of people into the amount of fuel used.

GRADE 11, UNIT VI, LESSON 1

Title: Can We Afford Plastics?

Purpose: To help students understand the complexities of the wise use of scarce fossil fuels

Procedure:

1. Begin the lesson by discussing that when one ton of coal is roasted in an airtight oven, we get: 1,300 to 1,500 pounds of coke, 8 to 10 gallons of coal tar, 3 gallons of light oil, 5 to 6 gallons of ammonia, and 9,500 to 11,500 cubic feet of coal gas.

2. From the light oil (Benzene), plastics are made. Benzene also can be used to make synthetic fibers, food preservatives, motor fuel, synthetic rubber, and tanning fluids. (Coal. The World Book Encyclopedia, 1973).

3. Only a small percentage of a ton of coal or a barrel of crude oil is used to make plastics.

4. Debate the pros and cons of using plastics in sports, recreation, medicine, packaging, your automobile, your home, and by farmers.

GRADE 11, UNIT VI, LESSON 1

Title: Can We Afford Plastics?

Purpose: To understand the importance of petroleum and natural gas as chemical raw materials

Procedure:

1. Request that two or three students do encyclopedic research to ascertain the termendous number of products being made today that use petroleum and/or natural gas as a basic material. The list, which could be illustrated in an effective bulletin board display, would include such things as lacquer, varnish, paint thinner, soap, mineral oil, salves, ointments, candles, detergents, waxes, asphalt, pitch, rubber, plastics, synthetic fibers, explosives, fertilizers, and many, many other important industrial chemicals.

2. Petroleum and natural gas are so critically important as "chemical stock" for the future that it is a very serious mistake to use these substances simply as fuel.

3. Ask the students who did the research to lead a class discussion focused on this idea. What responsibility, if any, does the present generation have for future ones?

4. If we reduce the use of petroleum and natural gas for fuel, what substitutes might be or are available? What other actions are possible?

GRADE 11, UNIT VI, LESSON 2

Title: Energy Management For Schools

Purpose: To involve the student in managerial decisions concerning energy conservation

Materials: Guest speaker from school board or school district office

Procedure:

1. Have a school official come talk to the class about school expenses for electricity, gasoline for school buses, heating oil, natural gas, and any other activity which requires energy.

2. After the students have gathered information about school expenditures, have the class write a plan for energy conservation in their school. For example, reserve special parking spaces for those who carpool, school buses that could pick up teachers as well as students, more efficient bus routes, and etc.

GRADE 11, UNIT VI, LESSON 3

Title: Natural Limits To Energy Supplies

Purpose: To become aware of the fact that nature limits energy supplies

Materials: Research materials

Procedure:

1. Have students investigate the natural limits to energy supplies: oil, coal, geothermal, wind power, solar power, nuclear power, water power, bioconversion, and any others the class can think of.

2. Have students prepare and give presentations, relating their findings.

Title: Environmental Costs Of Electric Power

Purpose: To understand environmental costs of electricity

Materials: Discarded nylon stocking, cardboard 1 ft. by 1 ft., 3 ft. broomstick, and a magnifying glass (optional)

Procedure:

1. Take the class on a field trip to your local power plant. Have the guide for the tour explain the steps taken in deciding where power plants are to be located, fuel sources to be used, process used to cut down on water pollution by heat transmission, to prevent air pollution from emissons given off by power plants' stacks, etc.

2. You may wish to have your students set up an acidic soot indicator near the electric plant. Many cases have been reported in which women's nylon stockings were ruined by something in the air. The cause of this damage has been attributed to the air pollution called "acidic soot." This pollution encompasses a number of pollutants such as hot particles in smoke, soot that contains acid, acid droplets, and solvent vapors. To see if your plant is giving off "acidic soot", prepare a stiff piece of cardboard 1 foot by 1 foot by making a hole in the center of the cardboard 6 inches by 6 inches. Next saw the 3-foot broomstick into 4 equal pieces. Nail the pieces to the corners of the cardboard, forming a small table. Then cut an 8-inch piece of nylon from the old stocking. To mount the nylon, make a slit in each corner of the cardboard, and work ends of the nylon into these slits. Don't stretch the nylon too tightly - just enough to remove wrinkles. Put the sample in a place where it isn't likely to be disturbed and inspect it about once a week (for at least a month) for fresh holes, broken threads, or runs. All could be caused by "acidic soot."

Title: Environmental Costs Of Electric Power

Purpose: To help students understand how a cooling tower works

Materials: 5-gallon can with its bottom removed and holes in its side
2 pieces of rubber tubing with 2 sprayers attached
A circular structure made up of porous asbestos materials
Large plastic collecting basin
Large fan
Thermometer
2 flat metal strips the diameter of the 5-gallon can

Procedure:

1. Have the students stick the 2 flat metal strips (the diameter of the 5-gallon can) through appropriate holes in the 5-gallon can forming a +.

2. The circular structure made of asbestos is pushed down the 5-gallon can to rest on top of the 2 metal strips.

3. The 5-gallon can is placed on the edges of the plastic basin.

4. A faucet is turned on that releases hot water. The faucet is allowed to run for awhile. Some hot water is then collected in a beaker and its temperature is taken. Turn off the water. A rubber tube with sprayer is then hooked up to the hot water faucet. The plastic container with the 5-gallon can on top of it is placed close to the faucet. The rubber tubing is run through a hole in the 5-gallon can set up so that hot water will spray over the circular structure made of asbestos.

5. The large fan is set on top of the 5-gallon can in such a way that it is blowing air upward and sucking air from the 5-gallon can. Turn on the water. Wait awhile and then record the temperature of the water in the plastic basin.

6. Questions

   Is the water in the plastic container cooler than the water that is coming out of the hot water faucet? How much? Is the cooling tower working?

Title: Environmental Costs Of Electric Power

Purpose: To examine the effects of acid mine drainage upon the biotic environment

Background: Runoff water from strip mine areas may be (and often is) very acidic.

Procedure:

1. Assemble the following materials:

   12 test tubes, water, pH paper, elodea sprigs, HCl solution (dilute), NaOH solution (dilute)

2. Have students work in groups of four to complete the following experiment. Fill each of 12 test tubes with an equal amount of water. Adjust the pH of the water by adding HCl or NaOH to achieve the following pH:

Tube	pH	Tube	pH	Tube	pH
1	2.0	5	4.0	9	6.0
2	2.5	6	4.5	10	6.5
3	3.0	7	5.0	11	7.0
4	3.5	8	5.5	12	7.5

3. Add a sprig of elodea to each test tube. Place test tubes in rack and place on a window ledge. Examine daily. Record any changes in color, size, or shape of the elodea. Rate the health of the elodea on a scale of zero-five. After one week to ten days determine at what pH death occurs.

SAMPLE DATA TABLE

	1	2	3	4	5	6	7	8	9	10	11	12	tube
date	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	pH

Key: 0 = dead, 5 = healthy

4. Have each student complete a lab report on the activity. This report should include the following items:

   Purpose (in the student's own words)
   Materials
   Procedure
   Data
   Discussion
   Conclusion

5. Discuss the following items with the class:

   a. What appears to be the pH at which elodea grows best?
   b. At what pH did the elodea die?
   c. What is acid mine drainage?
   d. Compare the pH at which the elodea can no longer live to the pH of water near strip mines.
   e. What do you suppose would be the effect of acid water (from stripped areas) upon the local vegetation?
   f. How can acid mine drainage be minimized or eliminated?

Title: Environmental Costs of Electric Power

Purpose: To study the effect of siltation and acidity on freshwater life

Concept: The production and distribution of energy have environmental and economic consequences.

Procedure:

1. Have students research the process of strip mining coal.

2. After discussing the process of coal removal by strip mining, discuss the possible effects of acid mine drainage and improper soil cover.

3. Divide the class into four groups. Have each group collect three liters of water samples from the same river, stream or pond into each of two wide-mouth, one-gallon glass jars.

4. Add a uniform amount of plant material to each jar. The eight jars should be loosely capped and returned to the laboratory where they are placed in indirect light and caps are removed.

5. Aerate four of the jars (A-D) to simulate river and stream conditions while the other four remain stagnant. Jars A and E will have 1 ml. of 1M H_2SO_4 added daily; jars B and F will have 5 grams of soil added daily; jars C and G will have both 1 ml of 1M H_2SO_4 and 5 grams of soil added daily; and jars D and H will be the controls.

6. Beginning the following day and then at least weekly for four to six weeks, have each group test two jars for the following:

   a. pH (with a pH meter or pHydrion paper)
   b. turbidity (with a Hach kit)
   c. color
   d. odor
   e. dissolved oxygen (Hach kit)
   f. dominant plant types
   g. dominant animal types

7. Collect rainwater to replace water evaporating from the jars. At the end of the experiment, the students should answer the following questions:

   a. Were the physical factors of the water samples changed with the addition of acid or soil?

   b. How did the addition of acidity or silt affect the succession of plant and animals?

   c. Which factor caused the most change? Why?

   d. What could be done to reduce the effects of the addition of acid and/or soil to fresh water?

Title: People View The "Crisis"

Purpose: To emphasize how energy shortages could be reduced by a few changes in our daily lives, and by using available technology

Procedure:

1. Present the following information giving possible energy savings in terms of number of barrels of oil saved.

If all houses had 6" insulation	600,000
If all houses were weather-stripped	580,000
If all thermostats were set at an average of 60°F	570,000
If all clothes were washed in cold or warm water	100,000
If all appliances were 20% more efficient	500,000
If the average load per commuter car increased by 1 person	700,000
If all vehicles were 1% more efficient	1,000,000
If all cars averaged 20.8 mpg	500,000

2. Which of these savings require changes in how we live?

3. Which of these savings require changes in technology?

4. Are there any that may require both changes?

5. The class could conduct a survey in their neighborhood to see if the community is willing to make the changes mentioned above to save energy.

Title: People View The "Crisis"

Purpose: To have students examine a process for evaluating energy-related matters.

Objectives: Students should be able to:

1. Define cost and benefit.
2. Explain how energy-related decisions involve costs and benefits.
3. Provide their own data in analyzing energy conservation measures, using the cost-benefits model.
4. Assess the trade-offs involved in energy related decisions.

Materials: Copies of ENERGY ISSUES: COSTS AND BENEFITS (at the end of this lesson), butcher paper, felt pens

Procedure:

1. Distribute copies of ENERGY ISSUES: COSTS AND BENEFITS.

2. Introduce students to the concepts, cost and benefits, explaining that for every decision related to energy, some groups benefit while others are hurt. The obvious example is OPEC's continued increases in the price of oil has far-reaching effects upon all Americans. For most of us, it has been a cost, but there are some groups for which there have been benefits (e.g., bicycle manufacturers). Students can see more readily how our whole economy is affected by one decision when they analyze the costs and benefits to various populations.

3. Divide class into small groups, assigning each group an issue to analyze using the example provided. Allow ten minutes for brainstorming as students examine the costs, benefits, and overall effects on our energy supplies. The teacher should circulate during the brainstorming session, encouraging students to consider the impact of the decision on various segments of the population. Students should record their data on butcher paper, using the format of the model provided. Assign or allow students to select a recorder and spokesperson for their group.

4. Bring groups together to share their analyses by having them tape their butcher paper to the blackboard. Allow students to walk around the room examining other group's responses. Then have group leaders summarize their group's data.

5. Assign individual research projects to students on energy issues that are somewhat more complex. Have them follow the same format in analyzing these issues.

   a. Building a home with a passive solar heating system. If there are any solar homes in their community, students can visit these before preparing their report.

   b. Call the local utility company to find out more about insulation, zero interests, weatherization, rate structures, etc.

   c. Interview a city council representative or state legislator and analyze a specific energy conservation proposal under consideration.

6. Have students analyze these energy decisions:

   a. Mandatory weatherization of homes within a five-year period.

   b. Riding mass transit.

   c. Raising the driving age to 18.

   d. Gas rationing - 10 gallons a week or per car.

   e. Requiring people to live in the area where they work.

   f. Cutting inter-school athletics (to save on fuel).

   g. Requiring annual automobile engine tune-ups. (to keep engines in peak energy efficient condition)

ENERGY ISSUES: COSTS AND BENEFITS (A Model)

ENERGY ISSUE	WHO BENEFITS?	WHO IS HURT?	HOW ARE ENERGY SUPPLIES AFFECTED?
Increased fuel costs	OPEC Oil Companies	THE CONSUMER	
	Bicycle and moped manufactuers	a. increased proportion of income spent on fuel.	
	Foreign and domestic small car manufacturers	b. increased cost of goods due to transportation and manufacturing costs.	Higher costs reduce consumption, thus stretching reserves.
	The environment in terms of less air pollution as a result of less mileage traveled by cars.	c. low income person has very limited mobility with high transportation costs.	
		d. low income persons may have to keep their homes at low temperature levels due to fuel costs.	
		Large car manufacturers	
		Independent truckers due to increased fuel costs which cut down on their profits	

Title: People View The "Crisis"

Purpose: To study two ways that are used to modify behavior and relate these methods to energy conservation

Objectives: The student should be able to:

1. Differentiate between energy conservation alternatives that provide incentive for reducing energy consumption and mandated energy conservation alternatives.
2. Provide examples from the media to illustrate both types of conservation measures.
3. Evaluate whether incentive or mandated conservation measures are better, given our present energy situation.
4. Develop other examples that illustrate both types of energy conservation alternatives.
5. Identify examples of both types of conservation measures that are in practice now.

Materials: Copies of CARROTS OR CLUBS (at end of this lesson)
A carrot
Bat (or other "club")
Student collected newspaper articles

Procedure:

1. The teacher can take a unique approach in introducing this lesson. Bring to class a carrot and a baseball bat or other club.
2. Ask: What do these two items have to do with energy conservation? (Be accepting of responses. It may take awhile for students to grasp this idea. List responses on the chalkboard.)
3. Then ask: In what ways could each of these items be used as behavior motivators? (Students should reach the idea that a "carrot" is a reward and a "club" is a punishment or a threat).
4. List student ideas on the chalkboard. Have students group the items on the chalkboard to stress the difference in "carrot" and "club" as motivators.
5. Now, get students to label the two different lists. Introduce the terms "incentive" and "mandate" and see if students can make an analogy between the word pairs (carrot/club) (incentive/mandate) (carrot is to incentive as club is to mandate).

6. Governmental policies to promote energy conservation may be categorized into two groups: CARROTS - those that are designed to motivate citizens by providing economic incentives to conserve - and CLUBS - those measures that are mandated by higher authorities. In choosing a carrot, the consumer is rewarded (e.g., tax rebates). By resorting to clubs, the consumer is penalized and usually pays a price, either economically or through restrictions on lifestyle.

7. Ask: Which approach do you feel is more desirable? (Carrots - incentives or Clubs - mandates)

8. Distribute student handout "CARROTS OR CLUBS" and go over the directions given on the worksheet. Allow 5 or 10 minutes for students to complete the assignment.

9. After students are finished with the activity, go over the headlines asking students how they view each of the measures and why they characterized the measures as "carrots" or "clubs."

10. Create a bulletin board using the articles students have brought to class. On one side of the board, place news items that represent carrots (incentives) and on the other side place news articles that represent clubs (mandates)

11. Reserach which carrots and clubs are already being practiced in the student's community and/or state. Interview a person on the city council or a state representative to find out about incentives and mandates that are under consideration.

12. Have students create a cartoon depicting examples of carrots or clubs. These should be energy-related.

HEADLINERS: CARROTS OR CLUBS

Read the following list of newspaper headlines. Then decide if the energy conservation measure is a CARROT or a CLUB. A carrot is any item that provides an incentive (usually economic) to conserve energy. An item is considered a club if it is mandated by a higher authority. Failure to respond to the club will usually result in a penalty.

On the line left of each headline, write whether the measure is a CARROT or CLUB:

___ 1. GOVERNOR SIGNS GAS RATIONING BILL
___ 2. CITY RAISES PARKING LOT RATES TO $5.00 PER DAY
___ 3. BANKS TO MAKE LOW INTEREST LOANS FOR SOLAR-EQUIPPED HOMES
___ 4. STATE TO PROVIDE 25% TAX CREDIT FOR COST OF INSTALLING SOLAR PASSIVE SYSTEMS
___ 5. PUBLIC SERVICE ANNOUNCES PLAN FOR FREE ENERGY AUDITS TO PRIVATE HOMES
___ 6. FINES IMPOSED ON LOCAL BUSINESSES FOR EXCESSIVE NEON LIGHTING
___ 7. 1% GAS TAX EARMARKED FOR BIKE AND PEDESTRIAN LANES
___ 8. SCHOOL BOARD CONSIDERING RESIDENCY REQUIREMENTS FOR ALL NEW EMPLOYEES
___ 9. ADDITIONAL FEDERAL MONEY TO BE AWARDED TO SCHOOL SYSTEMS THAT OFFER CLASSES IN ENERGY EDUCATION
___ 10. TOLL ROADS REINSTATED ON INTER-STATE HIGHWAYS. HIGHER TOLLS FOR SINGLE-PERSON AUTOS
___ 11. GOVERNOR SIGNS TUNE-UP BILL. INSPECTIONS TO BEGIN JANUARY 1
___ 12. ODD-EVEN GAS SALES BEGIN TODAY TO COMBAT LONG LINES AT GAS STATIONS
___ 13. UTILITY COMPANIES TO GIVE AWAY INSTALLATION DEVICES. COST TO BE ADDED TO EVERYONE'S BASE RATE
___ 14. SCHOOL BOARD CONSIDERING ACTION TO BAN STUDENT NON-ESSENTIAL DRIVING TO SCHOOL
___ 15. CITY RECEIVES FEDERAL GRANT TO BEGIN "FREE RIDE" PROGRAM. CITIZENS OFFERED FREE BUS SERVICE
___ 16. $5 MINIMUM PURCHASE IMPOSED BY AREA GAS STATIONS
___ 17. LEGISLATURE PASSES TAX PACKAGE FOR SOLAR HOMEOWNERS. NO ADDITIONAL TAX ASSESSMENT ON SOLAR EQUIPPED HOMES.
___ 18. LOCAL RADIO STATION BEGINS CAR POOL CAMPAIGN. CAR POOLS PICKED AT RANDOM BY HELICOPTER TRAFFIC CONTROL WILL RECEIVE FREE FOOTBALL TICKETS.
___ 19. GAS-GUZZLER TAX DEBATED IN STATE LEGISLATURE. ADDITIONAL SALES TAX CONSIDERED ON AUTO'S WITH MPG LOWER THAN 14.

Title: The Geography Of Energy

Purpose: To understand the international relationshiops in energy supply

Materials: Copies of ENERGY SUPPLY AND ENERGY DEMAND IN WORLD REGIONS (on following page)

Procedure:

1. Distribute the student worksheet ENERGY SUPPLY AND ENERGY DEMAND IN WORLD REGIONS.

2. Have the students complete the chart, and consider the following questions:

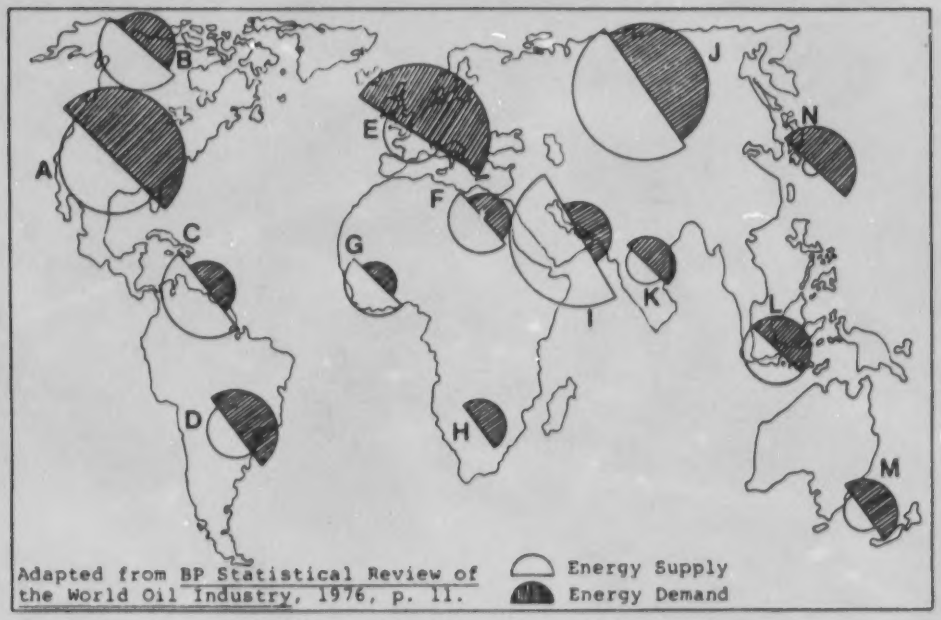
   a. Which seven regions probably have to buy oil from foreign countries?

   b. Which six nations have more oil than they need for their own use at the present time?

   c. Trade partners are those who have something to sell and those who need to buy. Find at least four possible trade partners. Partners can be used more than once in different combinations.

   d. In addition to the need for oil and the supply of oil, what other factors will influence which nations will be trade partners?

ENERGY SUPPLY AND ENERGY DEMAND IN WORLD REGIONS



Adapted from BP Statistical Review of the World Oil Industry, 1976, p. 11.

Put a check in the appropriate column. Base your choice on the information on the map. The first one has been done for you.

Code	Area or Nation	Supply Greater than Demand	Demand Greater than Supply	Balance Supply & Demand
A.	United States		x	
B.	Canada			
C.	Central America			
D.	South America			
E.	Western Europe			
F.	North Africa			
G.	West Agrica			
H.	South Africa			
I.	Middle East			
J.	USSR			
K.	South Asia			
L.	Southeast Asia			
M.	Australia			
N.	Japan			

Title: The Geography Of Energy

Purpose: To have students discover that not all growth trends are positive

Materials: Copies of RECENT TRENDS IN THE QUALITY OF LIFE - THE UNITED STATES and QUALITY OF LIFE - THE WORLD

Procedure:

1. Say: If improvements need to be made in our quality of life, they will not all require larger expenditures of natural resources and energy. In fact, to improve traffic congestion and reduce air pollution might require less, not more growth.

   Decisions about growth involve trade-offs. More growth, more consumption of resources will be needed to restore dilapidated housing, and less will be needed to reduce the use of private automobiles.

   Improving quality of life does not necessarily mean acquisition of more and more material goods.

2. Write the following key to the two charts on a transparency or the chalkboard.

CONSUMER PRICE INDEX: A numerical indicator keyed to 100, used to measure increases in prices over time. 1967 is used as the base year, or year when the CPI was 100. Ex: if the consumer price index for 1970 were listed as 124, this would mean prices had increased 24 points or 24% over that three year period.

PER CAPITA: Per person, or per head.

GNP: Gross National Product - The total, in dollars, usually in billions of dollars, of all the goods and services bought and sold in a country for one year. Used as a key indicator of a nation's material wealth.

INFANT MORTALITY RATE: The number of infant deaths per 1000 live births.

LIFE EXPECTANCY: Average age (usually given at birth) to which persons are expected to live.

LITERACY: Percent of a population above the age of 16 able to read and write a simple sentence.

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3. Distribute copies of RECENT TRENDS IN QUALITY OF LIFE - THE UNITED STATES

4. Ask: For which of the items listed on the chart has there been no increase, or a decrease, since 1960?

   Answers: Infant death rates for both Whites and Blacks; persons below the official "low income" level; purchasing power of the dollar; % of total defense outlays; recipients, needy families program; White male unemployment; Black male unemployment; railroad passenger miles.

5. In your opinion, which of the items that decreased represent changes for the good? Changes for the bad?

   Answers: Will vary according to students' perceptions.

6. Which increases on the chart might well show negative types of growth?

   Answers: To list a few examples - expenses for health; physician's fees; consumer price index; unemployment; crime statistics; motor vehicle deaths.

7. Which increases might indicate positive types of growth?

   Answers: To list a few examples - average weekly earnings; pollution expenditures, etc.

8. Add up the number of negative quality of life indicators. Which list is longer?

   Answers: Many students might have lists that are very close in length?

9. Which items appear to be growing exponentially? A. medical costs; B. prices; C. crimes; D. motor vehicle travel.

10. Distribute copies of QUALITY OF LIFE -- THE WORLD.

11. Ask: Is there a relationship between GNP and other indicators on the chart?

    Answers: In most cases, yes. This would indicate that raising the material well-being of poor countries, in particular, would most likely have a positive effect on the other aspects of their quality of life.

12. Which items would you like to see changed for: U.S.? Brazil? Ethiopia? China? U.S.S.R.? Explain why.

13. Look at the GNP and the literacy rate for China. Based on these two figures, could you conclude that China has a poor quality of life?

Answer: This dramatically points out the value dimension to quality of life. We would probably have to look at other indicators to evaluate China's quality of life. But the discrepancy between the two indicators shows that we need more than indications of material well-being to measure quality of life.

RECENT TRENDS IN QUALITY OF LIFE -- THE UNITED STATES

	1960	1965	1970	1974
Health				
Life expectancy at birth, female	73.1	73.7	74.8	75.3*
Life expectancy at birth, male	66.6	66.8	67.1	67.6*
Private consumer expenses for health care (in $ billions)	18.0	26.8	40.9	52.9*
Percent covered by private insurance	27.8	32.6	38.5	40.9
Physicians fees (1967=100)	77.0	88.3	121.4	150.9
Cost of semiprivate hospital room (1967=100)	57.3	75.9	145.4	201.5
Infant death rate, per 1,000 births				
White	22.9	21.5	17.8	15.8*
Blacks and other minorities	43.2	40.3	30.9	26.2*
Education				
Total school expenditures ($ billions)	24.7	40.2	70.2	98.8
Federal funds for ecuation ($ billions)	3.8	7.6	12.7	19.4
Millions of high school graduates	1.9	2.7	2.9	3.1
Millions of college graduates	0.4	0.5	0.8	1.5
Earnings				
Average weekly earnings (1974 dollars)				
All job categories	134	149	152	154
Manufacturing	149	168	170	176
Construction	188	216	248	249
Retail trade	96	104	105	101
Income and Prices				
Gross national product (in billions of 1958 dollars)	488	618	723	821
Per capita gross national product (in current dollars)	2,788	3,525	4,769	6,594
Median income of all families (current dollars, in thousands)	5.6	7.0	9.9	12.8
White families	5.8	7.3	10.2	13.4
Black and other minority families	3.2	4.0	6.5	8.3
Persons below official "low income" level (in millions)	39.9	33.2	25.4	24.3
White	28.3	22.5	17.5	16.3
Black and other minorities	11.5	10.7	7.9	8.0
Purchasing power of the dollar (1967 = $1.00 consumer prices)	1.13	1.06	0.86	0.68
Consumer price index (1967 = 100)				
Food	88.0	94.4	114.9	161.7
Rent	91.7	96.9	110.1	130.2
Fuel and utilities	95.9	98.3	107.6	150.2
Transportation	89.6	95.9	112.7	137.7
Medical care	79.1	89.5	120.6	150.5
All services	83.5	92.2	121.6	152.0

RECENT TRENDS IN QUALITY OF LIFE -- THE UNITED STATES (continued)

	1960	1965	1970	1974
Selected Federal Expenditures				
National defense ($ billions)	45.2	48.6	79.3	78.6
Percent of total federal outlays	49.0	41.0	40.3	29.3
Education and social services ($ billions)	1.0	2.1	7.9	11.6
Pollution control (in $ billions)	N.A.	N.A.	0.8	3.0
Recipients, needy families program (in millions)	4.3	5.8	4.1	2.4
Welfare				
Total social welfare expenditure ($ billions)	52.3	77.2	146.0	242.4
Number of retired workers receiving benefits (in millions)	8.1	11.1	13.3	16.0
Average monthly benefits paid to retired workers (in 1974 dollars)	129	137	154	188
Employment				
Unemployment rate (percent)				
Total	5.5	4.5	4.9	5.6
White	4.9	4.1	4.5	5.0
Female	5.3	5.0	5.4	6.1
Male	4.8	3.6	4.0	4.3
Black and other minorities	10.2	8.1	8.2	9.9
Female	9.4	9.2	9.3	10.7
Male	10.7	7.4	7.3	9.1
Persons 16-24 years old	11.2	10.1	11.0	11.8
Law Enforcement/Crime				
Total number of crimes (in millions)	3.4	4.7	8.1	10.2
Crimes per 100,000 people	1,876	2,434	3,961	4,821
Against persons	160	199	362	459
Against property	1,716	2,235	3,599	4,363
Homicides (in thousands)	8.5	10.7	16.8	20.6*
Public police protection ($ billions)	2.0	2.8	5.1	7.6*
Communications and Transportation				
Households with telephones (percent)	79	85	91	94
Households with TV sets (percent)	88	92	96	N.A.
Motor vehicle travel, vehicle miles (billions)	719	888	1,121	1,309*
Number of motor vehicles (millions)	74	90	108	131
Deaths, motor vehicle accidents (thousands)	38	49	55	46
Railroad passenger miles (billions)	21.3	17.5	10.8	9.3*
Air passengers carried (millions)	56	92	153	189

* 1973 (1974 figures not available.)

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QUALITY OF LIFE--THE WORLD
Selected Countries, 1978

	Population (in millions)	Per Capita GNP (in U.S. $)	Population per Physician	Infant Mortality Rate (per 1,000 live births)	Life Expectancy	Literacy-%	Daily Calories per Person	Daily Grams of Protein per Person	Military Expenditures (in millions U.S. $)	Education Expenditures (in millions U.S. $)	Health Expenditures (in millions U.S. $)
North America											
United States	210.4	6,154	612	18	71	99	3,330	106	78,462	73,300	35,902
Canada	22.1	5,318	615	17	72	94	3,180	101	2,405	10,004	7,061
Latin America											
Brazil	101.4	622	1,811	94	61	66	2,620	65	1,548	2,017	189
Mexico	54.3	892	1,392	61	63	76	2,580	62	344	1,259	242
Guatemala	5.5	459	3,957	79	53	38	2,130	59	21	61	38
Peru	14.9	613	1,818	110	56	72	2,320	60	340	356	101
Western Europe											
Great Britain	55.9	3,084	756	17	72	98	3,190	92	8,611	10,137	7,344
Italy	54.8	2,496	527	26	72	93	3,180	100	4,100	6,533	1,615
Sweden	8.1	6,111	690	10	73	99	2,810	86	1,729	3,980	3,234
West Germany	61.9	5,635	532	20	71	99	3,220	89	12,029	15,714	16,063
Africa											
Ethiopia	26.5	89	73,750	181	38	7	2,160	72	59	62	18
Ivory Coast	4.6	517	13,257	164	44	20	2,430	56	27	168	38
Kenya	12.4	181	8,914	135	50	25	2,360	67	32	121	34
South Africa	24.2	1,070	2,012	117	52	35	2,740	78	611	403	99
Uganda	10.8	158	9,008	160	50	25	2,130	61	52	53	20
Zaire	23.5	133	28,802	160	44	12	2,060	33	120	131	38
Algeria	15.7	519	8,200	128	53	26	1,730	46	138	675	114
Nigeria	71.2	177	23,753	180	41	25	2,270	63	648	240	50
Sierra Leone	2.6	179	15,706	136	44	10	2,280	57	4	18	5
Somalia	3.0	87	15,544	177	41	5	1,830	56	16	5	4
Asia and Middle East											
Egypt	35.6	258	1,516	103	52	26	2,500	69	1,726	393	199
Syria	6.8	359	2,906	93	54	31	2,650	75	389	95	12
Bangladesh	76.7	78	10,009	132	36	22	1,840	40	77	105	18
India	574.2	128	4,399	139	50	34	2,070	52	2,261	1,333	589
China	814.2	221	8,142	55	62	95	2,170	60	12,000	7,000	1,800
Indonesia	125.2	90	24,533	125	48	60	1,790	38	375	315	15
Japan	108.3	3,838	864	12	73	99	2,510	79	3,648	18,000	14,137
Philippines	40.2	262	1,490	78	58	72	1,940	47	165	292	46
Thailand	39.4	242	8,041	65	58	70	2,560	56	285	284	45
North Korea	15.0	364	2,286	110	61	85	2,240	73	625	154	11
South Korea	32.9	374	1,983	60	61	88	2,520	68	454	341	25
Oceania											
Australia	13.1	4,364	821	17	72	98	3,280	108	1,838	2,980	1,031
Eastern Europe											
USSR	249.7	2,498	369	26	70	99	3,280	101	67,000	43,000	20,600
East Germany	16.9	2,798	580	18	73	98	3,290	87	2,540	2,138	1,378
Poland	33.3	1,866	607	28		98	3,280	101	1,960	2,784	2,058

Title: Divestiture -- Why? Or Why Not?

Purpose: To review the energy crisis and how it came to be

Materials: Resources, media information from Department of Energy and from energy producers

Procedure:

1. Assign students to research all sources of energy production, energy resources, management of these resources and the effects on converting these resources into more desirable forms of useable energy.

2. Discuss the changes that have occurred when a principle source of energy was displaced by another source. (from wood to coal)

3. Make a time chart or timeline to show the principle energy sources used throughout history.

4. Discuss: Could energy producers create an artificial crisis? (Yes, supplies could be withheld and prices raised.)

5. Discuss: Could energy producers cause a "glut" to create a false sense of security? (Yes, the producers and distributors of oil products (gasoline, etc.) could flood the market and could lower the prices. People could be led to believe that we have plenty of fuel.)

6. Discuss if fossil fuels will ever "run out."

7. Have each student write a short report on "Why I Believe There Is An Energy Crisis."

Title: Supply Problems

Activity: Review of the Alaskan pipeline

Purpose: To learn that in developing an energy source a lot of the "old" energy must be used to produce "new" energy

Materials: Literature on the Alaskan pipeline and its construction.

Procedure:

1. Review the excitement surrounding the Alaskan oil discovery and how this country responded to the discovery of a new energy source that we could control.

2. Discuss how oil is transported from the well to a refinery and the energy required for this action:

   a. From oil well to heated storage tanks

      - energy was required to manufacture and transport the tanks
      - energy is required to heat the tanks

   b. Oil is pumped through the pipeline

      - energy was and is required to build, transport, and operate the pumps (located at intervals along the pipeline)
      - bridges and roads had to be built
      - the pipe must be heated at intervals to keep the oil flowing

   c. Tankers take on loads of oil at the end of the pipeline and transport oil to refineries

      - loading and shipping require energy

3. Research and discuss how much energy was and is being consumed just to maintain production from this oil field.

4. Research and discuss other energy-consuming processes required to get oil from field, refinery, to consumers.

5. Review the idea - there is nothing that is free!

Title: Mini-Battery

Activity: Find a way to store electricity

Purpose: To have students understand that power plants must be able to produce "peak" demand loads since they can't store electricity; therefore power plants generally do not work to capacity

Materials: Battery or models: Dry cell and lead acid

Procedure:

1. Discuss the nature of electricity - movement of electrons between two points having a different potential.
2. Discuss how a battery stores energy, and how that energy becomes useable after being stored.
3. Discuss the problem of storing electricity with present technology.
4. Show and explain different types of batteries.
5. Discuss a "perfect" battery and what characteristics it would need.

Title: Pay Now -- Or Pay Later

Activity: Producing alcohol for automobiles

Purpose: To show that the potential amount of alcohol from Florida's corn crop is of little importance

Procedure:

1. Say: In 1980 there were approximately 325,000 acres planted in corn in the State of Florida. Assuming an excellent yield of 100 bushels per acre, which can yield about 2.5 gallons per acre, we would have how much alcohol? (81,250,000 gal.)

2. Assume that motorists in Florida are using 4.9 billion gallons of gasoline annually, and that we could trade a gallon of alcohol for a gallon of gas, determine the percent of gasoline saved annually by converting the total corn crop to alcohol. (approximately 1.72)

3. In addition, we must use additional energy to distill the corn to produce alcohol.

4. Discuss the wiseness of such a commitment.

5. Discuss the reasons why and for what purposes corn is now grown in Florida.

Title: Pay Now -- Or Pay Later

Purpose: To recognize that obtaining equity in energy-related decisions can be an insurmountable task -- just ask any legislator

Objectives: Students should be able to:

1. Explain how energy-related decisions involve costs and benefits.
2. Provide their own data in analyzing energy conservation measures using the cost-benefits model.
3. Assess the trade-offs involved in energy-related decisions.

Materials: Copies of ENERGY ISSUES: COSTS AND BENEFITS (on next page)
Butcher paper
Felt pens

Procedure:

Assign individual research projects to students on energy issues that are somewhat more complex. Have them follow the same format in analyzing these issues.

1. Building a home with a passive solar heating system. If there are any solar homes in their community, students can visit these before preparing their report.
2. Call the local utility company to find out more about insulation, zero interest weatherization, rate structures, etc.
3. Interview a city council representative or state legislator and analyze a specific energy conservation proposal under consideration.
   a. Mandatory weatherization of homes within a five-year period.
   b. Riding mass transit.
   c. Raising the driving age to 18.
   d. Gas rationing - 10 gallons a week/car
   e. Requiring people to live in the area where they work.
   f. Cutting inter-school athletics (to save on fuel).
   g. Requiring annual tune-ups (to keep automobile engines in peak energy efficient condition).

ENERGY ISSUES: COSTS AND BENEFITS (A MODEL)

Energy Issues: Increased Fuel Costs

WHO BENEFITS?

- OPEC
- Oil Companies
- Bicycle and moped manufacturers
- Foreign and domestic small car manufacturers
- The environment in terms of less pollution as a result of less mileage traveled by cars.

WHO IS HURT?

- The Consumer, i.e.:
  a. Increased income spent on fuel.
  b. Increased cost of goods due to transportation and manufacturing costs.
  c. Low income persons have very limited mobility with high transportation costs.
  d. Low income persons may have to keep their homes at low temperature levels during winter due to fuel costs.
- Large car manufacturers
- Independent truckers due to increased fuel costs that cut down on their profits.

HOW ARE ENERGY SUPPLIES AFFECTED?

- Higher costs will reduce consumption, thus stretching reserves.

Title: The Second Coal Age -- Dig We Must!

Activity: Investigate the effects on the environment of burning coal

Purpose: To understand some of the concerns of converting back to the primary source of energy, coal or coal based

Materials: Resource materials, copies of newspaper article (next page)

Procedure:

1. Research the process of burning coal and the by-products emitted. (contact local utilities or the Department of Energy)
   a. Soot contains benzopyrene, the carcinogen in cigarette smoke.
   b. 14 toxic heavy metals are found in coal.
   c. Radioactive isotope in coal would add to the radioactivity of air.
   d. Burning coal could add as much nitrogen oxides as all the cars in the U.S., and
   e. Would produce 600 million tons of carbon dioxide annually.
2. Discuss the environmental concerns that will be posed by burning coal.
3. What will be the total cost to this nation if we convert back to coal as our primary energy source?
4. Discuss "acid rains."
5. Discuss the newspaper article ACID RAIN MONITORED AS IT FALLS IN FLORIDA from the Tallahassee Democrat, June 27, 1982.
6. Write a short report on the topic - "Coal - Life or Death."

Acid rain monitored as it falls in Florida

By WALTER PUTNAM
Associated Press

GAINESVILLE — It is known as acid rain, a phenomenon of an industrial age in which chemicals sent aloft mingle in the atmosphere and return as unnatural additives to normal precipitation.

Its effects have been documented in the Northeastern United States, Canada and Europe, where fish and wildlife have suffered because of the increased acidity in lakes and streams.

In Florida, there is a new effort under way to study the possible impact of a problem that until recently was thought to have little bearing on the Sunshine State.

"With more than 15 coal-fired power stations now under construction or planned in Florida alone, acid rain is going to become more widespread and troublesome, with potentially serious effects on lakes, fish, crops, forests and natural ecosystems," said Dr. Bob Volk, a University of Florida soil scientist who heads one research project.

Coal-fired power plants, which emit sulphur dioxide into the atmosphere, are thought to be one culprit in increased sulfuric acid levels in rainfall.

Super-tall smokestacks designed to protect local areas from pollution now send byproducts of the power-producing process high into the sky, where they can travel for hundreds of miles before returning in the rain.

In North Florida, at least six new coal-fired plants are in the planning stages or are under construction.

"The new coal-fired plants will permit some older, less-efficient oil-fired plants to be phased out, but there will still be an increase in harmful emissions across the northern portions of the state, not to mention what might drift in from other states to the north," Volk said.

In November 1980, the Florida Electric Power Coordinating Group, eager to establish facts for the utilities that formed it, hired a private environmental research company to study acid rain and to determine long-term effects.

The 11-week study by Environmental Science and Engineering Inc. of Gainesville measured the pH levels of rainfall in several areas.

The pH scale measures acidity and alkalinity on a scale of 0-14. Pure distilled water is a neutral 7. Anything below that is acidic and anything above is alkaline.

Normal rainfall is slightly acidic, with a pH measure of 5.6.

The study found a range of pH levels from 4.23 in Jefferson County to 5.13 in Monroe County, which consists largely of The Everglades and the Florida Keys.

On June 10, the state Environmental Regulation Commission urged Florida's congressional delegation to push for more federal research on acid rain.

The action came after a briefing about future conversions of electric generating plants from oil to coal. About 30 plants in Florida have been identified by the U.S. Department of Energy for possible conversion.

Ray Harry, Gulf Power Co.'s environmental-licensing supervisor, said the controversy surrounding the phenomenon has exposed the electric utility industry to severe criticism it may not deserve.

"There was a case in New York, in the Adirondacks, where the people noticed a decrease in the number of fish in their lakes," Harry said.

"Everybody just naturally blamed it on acid rain until they learned that the decrease in the number of fish occurred because the state stopped restocking the lakes with fish."

Title: The Second Coal Age -- Dig We Must!

Purpose: To determine the effects of gases emitted from the burning of coal in a closed terrestrial ecosystem

Materials: Sand, potting soil, coal, two species of plants (two of each), test tube, 22 X 180 mm, glass tubing, hypodermic needle, two one-gallon clear glass jars with wide mouths and lids

Procedure:

1. Into two one-gallon jars, add sufficient pea gravel to a depth of one inch. Making sure the soil is free from fungi, add a minimum of 1 and 1/2 inches of soil. Plant two species of a succulent variety of plant in each jar. Make sure specimens in the two jars are as similar in size and vigor as possible.

2. Drill a hole in the lid and insert a thin rubber diaphragm such as the plugs used in blood-collecting vacuum tubes. As an added protection against unwanted contaminants, use a paraffin seal between the lid and the jar. Add sufficient water to moisten the soil.

3. Screw on the lids and place in indirect sunlight. (Direct sunlight will cook the plants.) Keep both jars together and allow the jars to reach equilibrium.

4. Finally, grind one gram of high sulfur coal (or coal used in your area). Place the coal in a large test tube. Insert a small glass tube into a one-hole stopper. Connect the rubber tubing to the protruding glass tube. Then insert the entire apparatus into the end of the test tube.

5. To the end of the rubber tubing attach a hypodermic needle of sufficient size and length. Insert the needle into the diaphragm, making sure the opening is not blocked.

6. Heat the test tube containing the coal until all the coal has burned.

7. Observe the growth rates of the plants in each jar. Daily measurements should be taken. The gases from the coal should be administered daily for two weeks.

8. What effects did the burning of the coal have on the closed ecosystem? Explain.

9. How does this closed ecosystem compare with our biosphere?

10. Based on the data collected on this experiment, what do you think could be some of the possible effects of burning coal to our atmosphere.

Title: The Anti-Nuclear Lobby

Purpose: To show that media coverage of nuclear accidents has made all of us very aware of nuclear hazards but we are uninformed of the hazards of coal and oil powered facilities

Materials: U.S. Department of Labor Statistics, research materials

Procedure:

1. Review each fuel and related concerns to human safety:

   a. Coal

      - o cost in lives and injuries
      - o oil spills (ships and blowouts)
      - o air/water pollution

   b. Nuclear

      - o cost in lives and injuries
      - o effects of radioactive wastes on future generations

2. Discuss the importance of getting as much information (from all points of views) before forming opinions or taking stands.

3. Obtain news magazines and newspapers that contain articles concerning coal mining/burning and nuclear information. Look for information regarding effects on human safety.

Title: The Anti-Nuclear Lobby

Purpose: To identify and to give examples of propaganda techniques for the purpose of building rational decision-making skills

Materials: Copies of PROPAGANDA TECHNIQUES I and II
energy-related articles
advertisements

Objectives:

1. Students will be able to identify specific propaganda techniques in advertisements and commercials.
2. Students will be able to identify specific propaganda techniques in articles based on energy.
3. Students will be able to utilize propaganda to encourage conservation.

Procedure:

1. The energy crisis is alarming. In ancient Chinese the word "crisis" was written with two characters. The first meant "danger," but this danger does not automatically endow educators with a license to indoctrinate. Rather than yield to this tendency, recall that the Greek root of the word crisis means "decision." Thus decision-making skills should be a primary objective in education.

2. Have students bring in examples of advertising.

3. Introduce propaganda techniques as described in PROPAGANDA TECHNIQUES - I and II.

4. Have students find examples of each propaganda technique in advertising. Radio & T.V. commercials may be used. Role playing may be valuable.

5. Have students bring in articles on energy.

6. Have students identify specific propaganda techniques within the articles.

7. Discuss changing values and how they are affected by propaganda.

8. Plan advertising campaigns or write energy articles using propaganda to encourage conservation. Videotape productions could be planned and performed.

PROPAGANDA TECHNIQUES - 1

The Institute for Propaganda Analysis lists seven common propaganda techniques.

1. Name Calling - Applying some label that some people generally dislike or fear to a person, organization or idea. Such words as "racist" or "communist" may be used to discredit rather than describe accurately.

   Example - "Only an idiot would believe nuclear power can solve our nation's energy problems."

2. Glittering Generality - Connecting positive-sounding words to an idea, so that you will accept the idea without examining it.

   Example - "Farmers are the life blood of our country, harvesting energy from the sun to feed America. They can help solve our energy problems through gasohol."

3. Transfer - Using the reputation of some respected organization in connection with an idea.

   Example - "The Union of Concerned Scientists estimates that 10 to 17 percent of our uramium miners will die of cancer."

4. Testimonial - Quoting some well-known person in favor of a given product or policy.

   Example - "Energy Analyst Charles Kormanoff recently published an exhaustive study that shows electricity from nuclear plants will cost 20 to 25 percent more than power from modern coal plants with advanced pollution-removing scrubbers."

5. Plain Folks - Winning confidence on the basis that an idea is good because it is related to the common people.

   Example - "Ladies and gentlemen of the jury, the defendant cannot possibly be guilty of tampering with his electric meter to defraud the utility company, for he comes from a long, long line of hard-working, God-fearing, liberty-loving, and patriotic people just like yourselves."

6. Card Stacking - Selecting and using facts to give a false or misleading idea.

   Example - "Nuclear plants in the U.S. run at only 5 percent of their capacity."

7. Band Wagon - Urging you to follow the crowd and accept the idea because "everybody's doing it."

   Example - "...meeting the nation's energy needs should be a great national cooperative effort that enlists the imagination and talents of all Americans."

PROPAGANDA TECHNIQUES - II

1. Appeal to Pity - Seeks to produce sympathy and pity to influence your opinion.

   Example - "America's poor, already trapped by rapidly rising prices for food and housing, are expected to be hardest hit by a 50¢ a gallon tax on gasoline."

2. Appeal to Prestige - Urging the acceptance of an idea as a means of raising your status.

3. Appeal to Ridicule - Attempting to make fun of someone or something in order to influence your opinion.

   Example - "Conservation is ignored in the President's energy budget. Obviously, conservation is not good business for the oil companies that donated $280,000 to redecorate Ronald Reagan's White House living quarters."

4. Bargain Appeal - Attempting to get you to buy an item by appealing to your desire to save money.

   Example - "This is your last chance to buy a brand new Opex automobile at 1981 prices."

5. Appeal to Flattery - Attempting to persuade by flattering a person in an area in which he would like to excel.

6. Slogan Appeal - Promotes a favorable response or positive action through short, catchy phrases.

   Example - "Save It, Florida." "Extinct Is Forever."

7. Technical Jargon Appeal - Impresses with the use of technical language or unfamiliar words.

   Example - "Durawear tires contain durium, the bonding material that makes these tires wear for years."

8. Danger/Survival Appeal - Refusing to act in a certain manner will result in harmful consequences.

   Example - "The Union of Concerned Scientists predicts a one-in-five chance of a catastrophe for one of our current reactors during their 30 to 40 year lifespan."

Sources - Some examples were based on an article in the Tallahassee Democrat entitled "We Don't Need Nuclear Power" by Ira Scorr, June 21, 1981.

Title: The Unanswered Question -- Nuclear Wastes

Purpose: To inform students about the costs and benefits of nuclear power

Materials: Cards with the five selections: Environment, Safety, Independence, Economics, and Politics of Nuclear Power

Procedure:

1. Prepare the cards, select five students and give each a selection to read.

   CARD 1.
   Environment - Nuclear power plants do not cause the same type of air pollution as coal power plants. Since the energy potential of uranium is great, only small amounts of ore must be mined. This reduces the problems of strip mining. Nuclear fission does produce radioactive material that is poisonous, highly corrosive, and must be kept carefully stored in geological stable areas for thousands of years. This storage problem has not been solved.

   CARD 2.
   Safety - There are no radioactive emissions that are dangerous to people living near the plant because of strict safety precautions. While the plant can't explode like a nuclear bomb, it is possible for mishaps to occur and unplanned leakage of radiation to result. There is also a danger that hi-jackers could steal nuclear material and make a bomb; especially true if we decide to use breeder reactors.

   CARD 3.
   Independence - The increased use of nuclear power could replace some oil and help the U.S. to be less dependent on foreign nations for energy. Uranium is the primary ore used in nuclear plants. Estimates on the amount of recoverable uranium in the U.S. vary; possibly 30-40 years worth.

   CARD 4.
   Economics - Nuclear power plants are fairly economical to operate, but very expensive to build. If the U.S. builds a large number of nuclear reactors, less money will be available to invest in other energy sources.

   CARD 5.
   Politics - Nuclear power plants are large. They often provide energy for many states. Few people are willing to allow plants to be built in their community. Until the problem of long-term storage of wastes is solved, several states have passed laws blocking the licensing of additional nuclear plants.

2. Ask: Is electricity from nuclear reactors worth the risk?

Title: Lifestyles And The "Energy Crisis"

Purpose: To understand the relationship between the standard of living and energy use

Materials: Conservation Survey

Procedure: Have students complete the survey individually. Compile the answers to the questions. Which of these energy uses are necessities? Which are luxuries?

Conservation Survey

Place an A if you agree, B if you disagree, or C if you can't make up your mind.

___ 1. Raise the price of gasoline by $1.00.

___ 2. Raise the age at which a person can drive to 21.

___ 3. Close gasoline stations on Sunday.

___ 4. Lower anti-pollution requirements.

___ 5. Ban the use of recreational vehicles, minibikes.

___ 6. Ban the use of motorboats.

___ 7. Lower the temperature to 65°F in all public buildings in winter.

___ 8. Raise the temperature to 80°F in all public buildings in summer.

___ 9. Close school in December and January and open them in the summer in cold climates.

___ 10. Provide free public transportation.

___ 11. Put tolls on all major roads.

___ 12. Ban auto racing.

___ 13. Ban school sports activities when travel to game would be more than 10 miles.

Title: The Environment And The "Energy Crisis"

Purpose: To involve the student in energy production with little environmental effects

Procedure:

1. Contact Kaplan Enterprises (Bartow, Florida) for information on how they use cattle feed-lot wastes to produce energy.

2. Discuss bioconversion - the process of getting fuels from animal and plant wastes.

3. Have each student develop an advertising campaign encouraging the conversion of fuels from plants and wastes.

Title: A "Sunlit" Future?

Purpose: To investigate which material stores solar energy the best

Materials: Cardboard box, black paint, 4 small metal cans, 4 thermometers, sand, salt, water, and torn-up paper.

Procedure:

1. One of the biggest problems of making widespread use of solar energy is finding ways to store it when the sun is not present.

2. Do this experiment:

   a. Fill the cans with their appropriate material - one sand, one salt, one water, and one with torn-up paper.

   b. Place a thermometer in each one.

   c. Paint the cardboard box black and put the cans in the box.

   d. Place the closed box in the sun for ½ hour.

   e. Read the thermometers and record temperatures.

   f. Remove the cans and watch the temperatures fall.

   g. Stir occasionally.

   h. Which temperature falls the slowest?

   i. Which stores solar heat best?

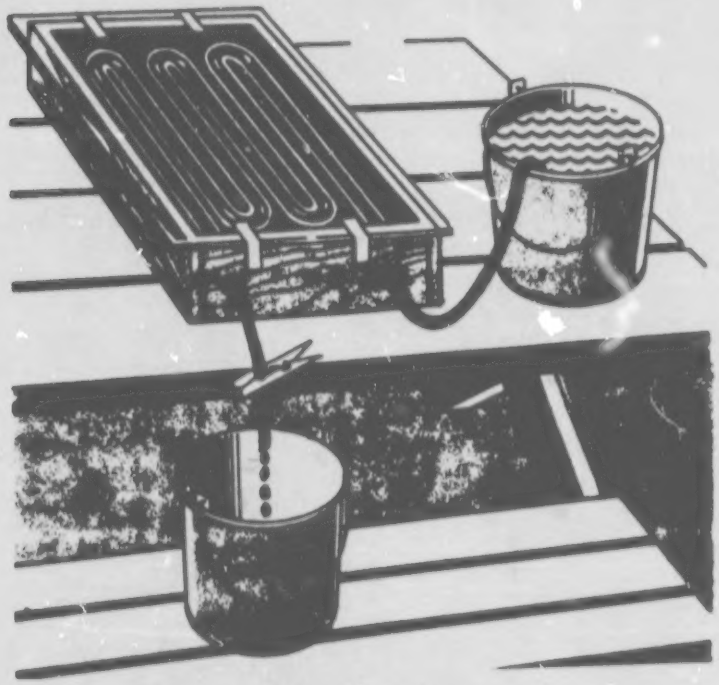
Title: Appropriate Technology

Purpose: To understand the need for new technology to subsidize available energy supplies

Materials: 10' of flexible black tubing; shallow cardboard or wooden box approximately 12" by 18"; flat black paint, paper, or cloth; piece of window glass; spring-type wooden clothespin; tape; and two empty cans or buckets.

Procedure:

Cover the insides of the box with black paint, paper, cloth, or other dark material. Then loop the tubing back and forth inside the box. Arrange for both ends of the tubing to be sticking out of the sides of the box a couple of feet. (See sketch below). Next, place the glass cover on the box and secure it with tape. Place the collector on a stand, with a can or bucket of water next to the collector and the other slightly below the collector. Put one of the tubing ends into the water. Suck gently on the other end to establish a siphon action. Pinch the tube partially with the clothespin to limit the flow of water. Notice after a while, the water coming out of the collector is warmer than that going into the collector. How warm the water gets will depend mostly on the time of year, how clear the skies are, and how slowly the water flows through the collector. Calculate the savings of using a solar water heater instead of an electric water heater.



Title: Sun Gods

Purpose: To help students recognize that they can harness the sun's energy for their own use

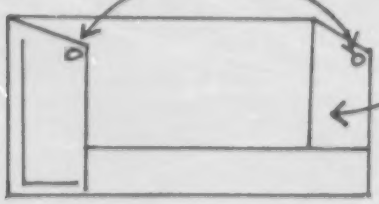
Materials: hot dogs, cardboard boxes, aluminum foil, coathanger, thumbtack, string, pencil, 2 small nuts and bolts, and rubber cement.

Procedure:

DO THIS FIRST:

Cut the top and front out of a cardboard box to make a frame for your solar cooker!

Poke holes here for nuts and bolts!



THEN, DO THIS:

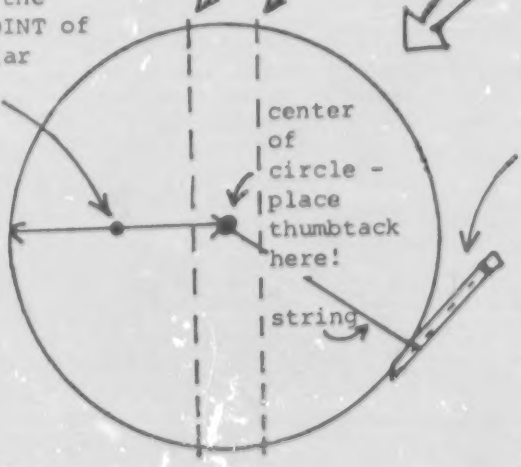
Make 2 large cardboard circles like this:

Measure the radius of the circle, and make a mark halfway.

This is the FOCAL POINT of your solar cooker.

cut on dotted lines

Use the string to hold the pencil, and attach the other end to the thumbtack. Hold the pencil tightly, straight up and down, and draw a circle on a piece of cardboard! Then, cut apart as shown.



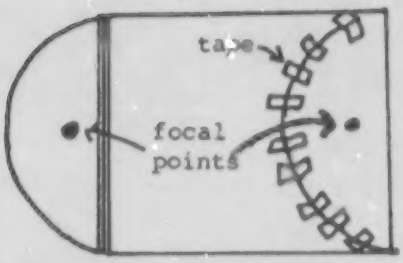
match focal points

Now, glue 2 pieces together to make 1 that's twice as heavy!

Do this with both circles you cut.

NOW, PUT THE 2 CURVED PIECES TOGETHER LIKE THIS:

Cover all of inside with aluminum foil!

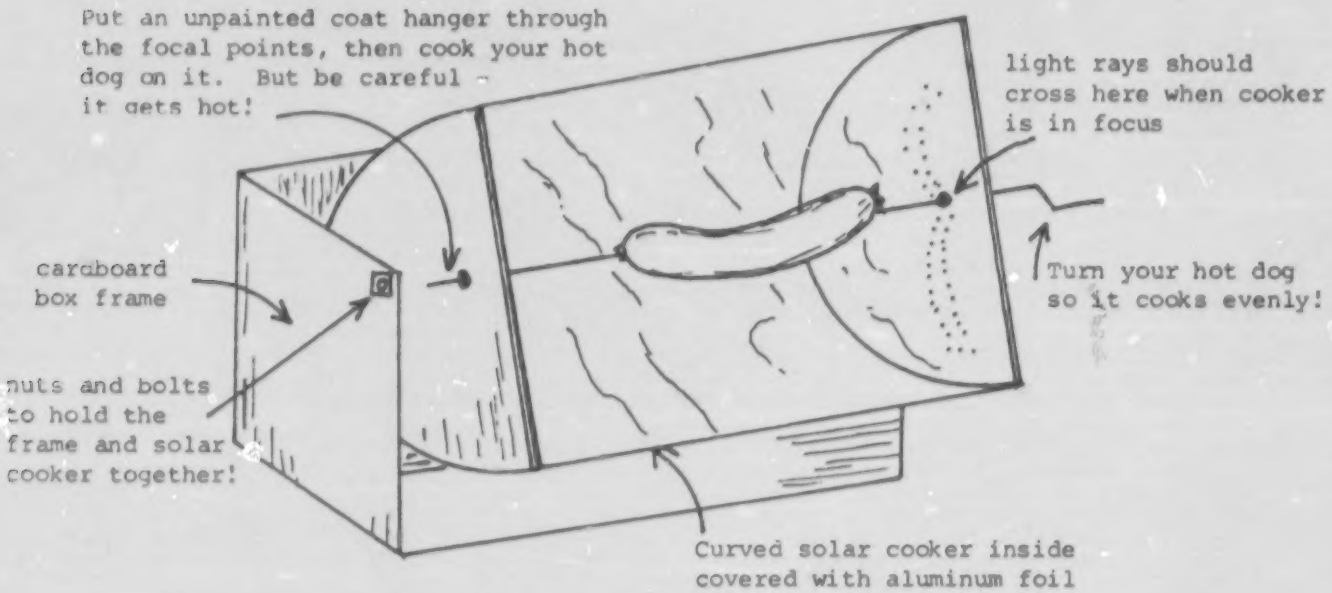


Tape another piece of cardboard to the curved edges of the 2 half circles you glued together -

the width of the piece of cardboard should be slightly less than the width of the box you cut to make a frame!

Then, cover the inside of this piece with aluminum foil - use rubber cement!

ADJUST THE COOKER SO THAT YOU CAN SEE THE SUN'S RAYS CROSS ON THE FOCAL POINTS. HOW LONG DOES IT TAKE TO COOK A HOT DOG?


Put an unpainted coat hanger through the focal points, then cook your hot dog on it. But be careful - it gets hot!
light rays should cross here when cooker is in focus
cardboard box frame
Turn your hot dog so it cooks evenly!
nuts and bolts to hold the frame and solar cooker together!
Curved solar cooker inside covered with aluminum foil

Title: Back To The Good Old Days

Purpose: To determine how much energy in gallons of oil we use today to grow the foods we eat

Materials: Copies of THE ENERGY REQUIRED TO PRODUCE FOOD PRODUCTS CONSUMED IN A YEAR BY ONE PERSON

Procedure:

1. Have students complete the chart on the next page and discuss the results.
2. Which foods require the most gallons of oil for their production?
3. Which foods require the least?
4. Which two animal products would you eat if your only consideration was to choose energy-efficient products? (The higher the ratio, the more efficient the forming process.)

The Energy Required to Produce Food Products Consumed in a Year by One Person

Plant Product	Food Consumed (lbs/person/ Year)	Energy Required to Produce Food (gallons of oil/ person/year)	Ratio (lbs/gals)
Flour & Cereal	140.0	2.2	64
Sugar	122.0	1.4	___
Vegetable Oils	41.8	3.7	___
Fruits	131.5	1.9	___
Potatoes	104.9	0.6	___
Beans, Peas & Nuts	16.1	1.8	___
Green & Yellow Vegetables	215.1	2.3	___
Miscellaneous	14.8	0.2	___
	786	14.1	

Animal Product	Food Consumption (lbs/person/ Year)	Energy Requirement (gallons of oil/ person/year)	Ratio
Beef	116.0	19.1	___
Dairy	356.0	4.7	___
Pork	67.4	4.8	___
Animal Fats and Oils	14.6	3.5	___
Poultry	52.4	1.6	___
Eggs	39.0	1.3	___
Veal and Lamb	5.5	0.8	___
Fish	15.2	2.1	___
	666.1	37.9	

Title: Back To The Good Old Days

Purpose: To acquaint the students with the term "investment"

Objectives: Students should be able to:

1. Define investment.
2. Identify savings or borrowing as the source of investment.
3. Apply the concept of tradeoffs to investment decisions.
4. Distinguish between short and long term benefits and costs.

Materials: Duplicated copies of Aunt Tillie and Her Gift (at end of this lesson)

Teacher Information: Often the concept of investment is not familiar to students, although they may feel the word is part of their vocabulary. The emphasis must be that an investment is the use of a present asset to produce future income or economic return or benefit. Students use a checklist to distinguish between a consumer purchase and an investment. Finally, students analyze the decision to insulate a home. The idea that trade-offs must be made between present pleasure and future returns is stressed.

Procedure:

1. Brainstorm with the class the meaning of investment. If possible, write all answers on a chalkboard or on butcher paper (save these notes).

2. Ask the class how time can be invested. (Students can work or study after class or "goof off" or sleep.) If an investment promises a greater reward, why should they not invest all their free time?

3. Distribute copies of student handout AUNT TILLIE'S GIFT. Although the names and circumstances may be a bit farfetched, the idea of choosing between consumption and investment is not.

4. After students have completed their checklist, discuss the following:

   a. Which choices give pleasure right away?

      (In most cases, the consumer goods such as the stereo or car give present pleasure while the savings bonds and college tuition give deferred pleasure. College can be a mixture of present pleasure (the experience of college itself) and deferred pleasure (the possibility of increased earning power.)

   b. How would you define investment?

      (List student responses on chalkboard.)

c. How do economists define investment?

(Investment is the use of a present asset to produce future income or economic return or benefit.)

5. Have students classify those items in the checklist they think are consumer items and those that mean investment. What is the difference?

(Choices 1,2,5 and 12 are investments since they will help to create income. It should be mentioned that college is both a consumer good and an investment. If a student explains that the purchase of gasoline is for a business purpose, it too can be considered an investment - but not loosely.)

AUNT TILLIE'S GIFT

A. Your Aunt Tillie gives you $1,000 on your graduation day. She tells you that she hopes you will spend it wisely, but what you do with it is your decision. You consider the following choices. Check how you think you would spend $1,000. Allow yourself just <u>one</u> choice.

_____ down payment on a car
_____ stereo system
_____ clothing
_____ tuition for college or job training
_____ stocks/bonds
_____ long trip
_____ buying equipment to start small business (i.e., lawn care, photography)
_____ hobby items (darkroom, records/tape)

1. Which choices mean you can't use them right away? List these choices.

2. Why might someone choose something that couldn't be used immediately?

B. The list of items below can be classified under the headings of Consumption or Investment. Read each item. Circle C if the item illustrates consumption. Circle I if the item probably means an investment. Circle B if the item could very well fit both categories.

C I B 1. College education

C I B 2. Buying an apartment building

C I B 3. Renting an apartment

C I B 4. Buying a shirt

C I B 5. Getting a haircut

C I B 6. Paying an electric bill

C I B 7. Buying barber supplies

C I B 8. Buying a solar heater

C I B 9. Filling your gas tank

C I B 10. Buying a stereo

C I B 11. Buying a new amplifier for your band

C I B 12. Buying a pickup for a delivery business

Title: Energy Policy -- Or Non-Policy

Purpose: To stress to the students a need to conserve our present energy supplies

Materials: Transparency of the U.S. Energy Gap: 1970 to 2000

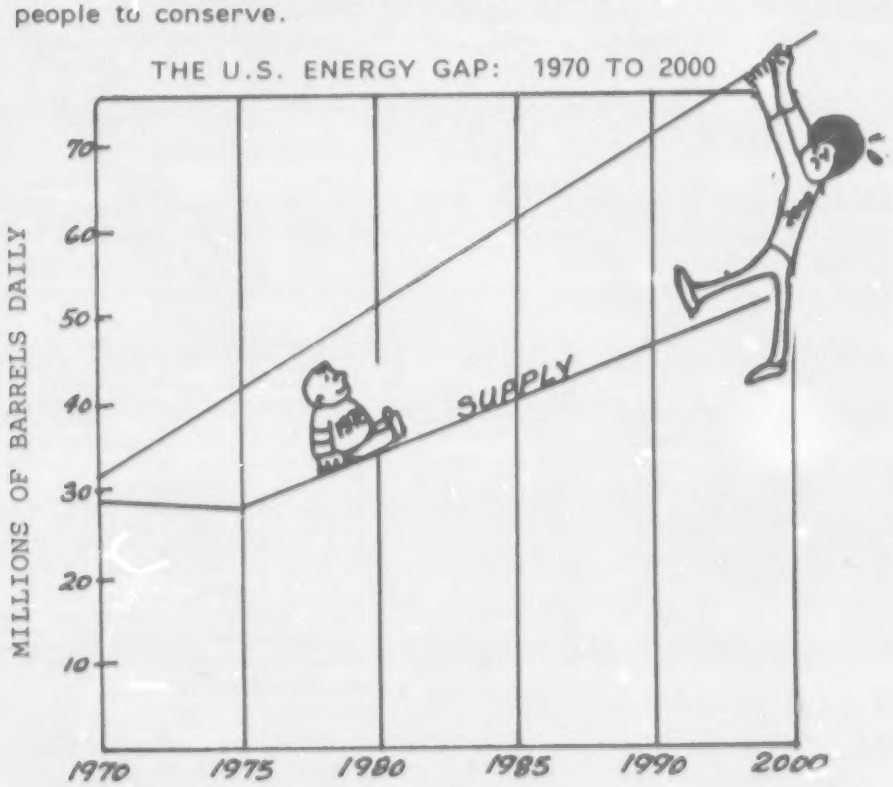
Procedure:

1. Have the class develop a working definition of "scarcity." (The desire for goods is greater than the supply of goods.) A point to emphasize is that scarcity, unlike shortage, is long term.

2. Show the U.S. Energy Gap: 1970 to 2000 to the class and ask these questions:

   a. According to the graph, what happened to the demand for energy between 1970 and 1975.
   b. What will happen to energy consumption by 2000?
   c. What will happen to energy supply?
   d. Why is 2000 trying to pull down the Demand Curve?
   e. Is there a reason why we should conserve?

3. Have the students create a motto or bumper sticker to encourage people to conserve.



Title: Energy Policy -- Or Non-Policy

Purpose: To have students review energy plans and design an appropriate model for their community

Materials: Two case studies: Davis, California and Portland, Oregon

Teacher Information: Students should be able to: acquire the knowledge of what information is necessary before an energy plan utilizing appropriate alternative technologies can be adopted, assemble that information in a useable form, and match appropriate alternative technologies with the correct end uses.

Procedure:

1. Obtain energy plans from Davis, California and Portland, Oregon.

Case Study #1: Davis, California

2. Hand out the readings on the Davis and Portland energy plans. The Davis plan deals with many aspects of appropriate technologies, but primarily with utilizing solar energy systems in conjunction with comprehensive conservation measures. Since Davis is a residential and university community, this plan, instituted in 1975, is an excellent example of how a locality may devise its own appropriate alternative energy plan.

3. Have each student read the two plans and write a critical examination of the Davis plan in the form of a newspaper editorial. Students may focus on one aspect of the plan, such as the building codes, or may discuss the overall plan. Students should be reminded to make use of the six factors which determine appropriateness together with other materials from the previous lessons to back up their opinions.

4. Permit students to choose their own positions or assign viewpoints to be defended. The plan may be criticized for going too far politically, environmentally, constitutionally, and economically, or for not going far enough. The teacher may wish to limit students to 500 words.

5. A few editorials representing a variety of approaches should be shared with the class.

Case Study #2: Portland, Oregon

6. The teacher should introduce the idea of creating a model energy plan designed for the students' own community. Divide the class into four working groups to deal with the four sectors of the community: residential, commercial, industrial and transportation. The commercial sector may include institutions (schools, hospitals, and government agencies); however, the teacher may wish to equa-

lize the work load by assigning these to other sectors. Distribute the five readings for the Portland, Oregon, plan to all members of the class.

a. the Energy Policy Statement of Mayor Neil Goldschmidt*
b. the Economic Base of the Portland, Oregon, Standard Metropolitan Statistical Area
c. The Portland Facts and Living Conditions sheet from the Chamber of Commerce
d. the proposed Energy Policy for Portland
e. the Summary of Energy Policy

7. Each of the four groups should study and outline in detail all aspects of the Portland Energy Policy which are pertinent to that group's sector assignment. Student groups should assign specific individuals to research specific components of a sector; for example, one student may be assigned to trucking, other to private automobiles, some to shipping. At this point, the teacher may suggest the necessity for building primary, secondary and even tertiary systems. In other words, show the necessity for back-up systems or diverse systems, which are more resistant to catastrophe than centralized, single-technology systems.

8. Group members should list all information they think will be needed to create the energy policy for their assigned sector. Each group should present the kinds of data it is seeking on the blackboard so that other members of the class can either ask questions or make suggestions.

9. Announce the following restraints:

a. The transportation sector will be restricted to 50% of its present consumption of oil;
b. The residential sector will use no fossil fuels;
c. The industrial sector will use no oil;
d. The commercial sector will use no fossil fuels.

In addition, the residential, industrial and commercial sectors will be permitted to use no large centralized generation of electricity. Remind students to consider the six factors which determine appropriateness as they design alternative energy systems for their systems.

*Speech presented to the City Council at the meeting designed to implement this energy policy. As of August 7, 1979, the policy has not been implemented. Neil Goldschmidt is now Secretary of Transportation for the U.S.

Suggested Schedule for Activities

Day 1 Introduction of project: designing an energy model for the student's own community.

Sector assignments - four working groups: residential, commercial, transportation, industrial

Reading: the Portland Plan: five selections:

1. the Energy Policy Statement of Mayor Neil Goldschmidt
2. the Economic Base of the Portland, Oregon, Standard Metropolitan Statistical Area
3. the Portland Facts and Living Conditions sheet from the Chamber of Commerce
4. the Summary of Energy Policy

Day 2 Student groups do preliminary planning for gathering of data.

Student groups assign specific individuals to research specific components of a sector.

Teacher may provide additional sources of information in the community.

Teacher announces restrictions for each sector.

Day 3 Student groups draw up specific objectives for appropriate energy technologies and conservation measures for their sectors; students develop specific programs for each segment of each sector.

Day 4 Each student group combines individual segments to come up with an energy policy for its sector. (The policy should follow the format of the Portland plan, including objectives, quantitative justification, and programs.)

Day 5 A comprehensive energy plan for the community is put together and presented to the class.

Day 6 Members of the class criticize the plan by writing editorials examining the programs proposed by other sectors; e.g., transportation may present a critique of residential, etc.

Title: Energy And The Developing Nations

Purpose: To help the students understand the concept of "petrodollars"; the problem of too much money

Materials: Monopoly game

Procedure:

1. Begin this lesson by recalling the game of Monopoly.

2. Ask: What happens when one player controls all the railroads, Park Place hotels, and Boardwalk hotels, too?

3. Why do other players run out of money when they land on your "property"?"

4. Point out the game of Monopoly is like the world trade in oil. With the increase in the price of oil, there has been a huge increase in the amount of money in OPEC nations. This income is being used to help OPEC nations develop housing, health care, education, industries, and defense. Even with these programs underway, the OPEC countries have enormous amounts of money. They have begun to reinvest this money in other nations' industries. This reinvestment of their oil money is referred to as "petrodollars".

5. Have a small group of interested students devise a game similar to Monopoly. Change the board to include oil wells, industries of different nations; change the cards to include vast winnings in petrodollars, etc.

Title: Who Limits Energy Supplies?

Purpose: To investigate the 55 mph speed limit and its environmental benefits

Materials: Transparency of the table below or copy on the chalkboard

Procedure:

Look at the following table. Then answer the questions.

Pollutant	Pounds Per 1000 Gallons
Nitrogen Oxides	133
Hydrocarbons	130
Carbon Monoxide	1534

1. There were 100 billion gallons of gasoline consumed by all forms of transportation in 1976. Compute the amounts of each of the three pollutants which were released by burning this amount of gasoline, and determine by what percent they increase the national totals. (Hint: You will have to convert pounds per 1000 gallons to millions of tons.)

Pollutant	National Total (In Millions of Tons)
Nitrogen Oxides	22.5
Hydrocarbons	30.4
Carbon Monoxide	94.6

2. Driving at 55 mph instead of 70 mph can save 11 million gallons of gasoline per day.

   - o How much gasoline could be saved a year?
   - o By what percentage would this have reduced U.S. gasoline consumption in 1976?

3. How much pollution could we have been spared if the 55 mph limit had been enforced in 1976? (Hint: Each pollutant would be reduced by the percentage calculated in problem 2.)

Title: Energy Crisis -- Leading To Conflict?

Purpose: To demonstrate the dangers of competition for limited energy supplies

Procedure:

1. Design a role playing activity as follows.

   Dilemma:

   a. The world is in a tremendous upheaval with pollutants killing millions a day.

   b. The U.S. through its space exploration can evacuate 100 people.

   c. It is down to the last five people to be evacuated and they must be selected from the members of the class.

2. Allow the class to devise a system for selecting the five.

   Warning: This type of role playing may lead to hostile reactions and bad feelings.

3. Relate this dilemma enacted in the classroom to the dangers of competition among nations for limited energy supplies.

Title: A Four-Day Week?

Purpose: To deal with the impact of a possible four-day workweek

Materials: Copies of a community survey devised by students

Procedure:

1. Have students prepare a survey regarding a possible four-day workweek. Possible questions to include in the community survey:
   - o If our country went to a four-day workweek, which day would you choose to have off?
   - o What would you do on your day off? Would you use more energy than if you were at work?
   - o Would you be willing to work ten hours a day rather than eight hours?
   - o What about the economic effects? A cut in salary?
   - o Are you willing to receive a smaller paycheck to have another day off work?
   - o Do you think the four-day workweek would have an impact on businesses?
   - o On leisure-time activities?
   - o How might it change your lifestyle?
   - o How would energy be saved if you worked a four-day workweek?
2. Survey the community.
3. Compile and discuss results of the survey.
4. What are the benefits of a four-day workweek?
5. What are the disadvantages of a four-day workweek?
6. Have students write a paper entitled "How A Four-Day Workweek (Schoolweek) Would Affect My Lifestyle."

Title: Energy And Society

Purpose: To demonstrate the changes in society caused by the dwindling energy supply

Procedure:

1. Have the students select a business to visit and ask the manager how his/her business intends to cope with dwindling energy supplies. (For instance, shorter store hours; curtailing billboard lighting; etc.).

2. Also have some students discuss with the police department the effects of lowered lighting levels on streets and in stores. (increase in crime and accidents perhaps)

3. Have students report to the class their findings and discuss the information gathered.

Title: Energy And Society

Purpose: To have students examine a series of headlines from the coal strike of 1978 to see some of the effects of a sudden shortage of fuel and make decisions about how to allocate fuel after a shortage cuts off needed fuel supply

Materials: Copies of WHAT TO DO WHEN THE OIL DOESN'T ARRIVE (on next page)

Procedure:

1. Give each student a copy of WHAT TO DO WHEN THE OIL DOESN'T ARRIVE.

2. Have the students work in small groups to complete the questions on decision making.

2. Have students set up and participate in a mock town council meeting. You will need the following people:

Mayor	-	Keeps order, announces the vote, votes in case of a tie.
Six Council Members	-	Listens to reports, proposes, plans, votes.
One Recorder	-	Keeps minutes.
Citizens	-	All other class members are to attend the board meeting. They are citizens of the community and have the right to speak out in favor of a proposal or against a proposal offered by someone else.

4. Have students define the term "shortage." (A sudden change in the supply or demand for an item.)

   Accept answers that show they understand the term even if they do not use the words supply and demand.

5. Have students list other shortages they have experienced. (These can be personal, such as have unexpected dinner guests when there is only a limited amount of food; or national, such as a shortage of oil during the oil embargo.)

WHAT TO DO WHEN THE OIL DOESN'T ARRIVE

A severe winter storm struck the entire New England region. All deliveries stop. An oil tanker making its way up the Bay was destroyed in the storm. One community was particularly hard hit by earlier storms and was very low in heating oil. A few oil trucks that had arrived in the community before the storm could make deliveries. If the oil was evenly distributed, all buildings would be out of oil after three days.

List as may reasons as you can for:

Delivering oil to all buildings	Delivering oil to some buildings
1.	1.
2.	2.
3.	3.
etc.	etc.

What other options were open to the community?

Choose the solution that you think was best for distributing the remaining oil.

What are the drawbacks to your solution?	What are the advantages to your solution?
1.	1.
2.	2.
3.	3.
etc.	etc.

Why did you choose your plan?

GRADE 12, UNIT VII, LESSON 2

Title: Energy And The Environment On A Collision Course

Purpose: To encourage the student to consider the environment when developing the energy source of the future

Procedure:

1. Ask each student to develop his/her own new, non-polluting energy source of the future - possibly in a picture form.

2. Have students give presentations describing their new future energy source.

GRADE 12, UNIT VII, LESSON 3

Title: Lessons Of The Fuel Crisis

Purpose: To sum up all that has been learned from the energy lessons

Procedure:

Have the students list the things they have learned through the energy lessons and have a group of students compile these lists for presentation of their findings to the entire school body and possibly making a community presentation. (Incorporating skits, songs, slide show, jokes, cartoons, and etc., in the presentation making the energy situation an entertaining learning tool.)

VOCABULARY - "ENERWORDS"

Ampere - A unit of measure for electric current.

Appliance - A device which does a special job, usually electric.

Barrel - A liquid measure of oil, usually crude oil, equal to 42 gallons or 306 pounds.

Bituminous Coal - Soft coal, high in volatile matter.

British Thermal Unit (BTU) - A unit of heat energy - the amount of heat necessary to raise the temperature of one pound of water one degree Fahrenheit.

Brownout - The lowering of power supplied to customers by a power company when power demand exceeds generating capacity.

Calorie - A unit of heat equal to the amount of heat necessary to raise the temperature of one kilogram of water one degree Celsius; equal to 1000 small calories.

Carbon Dioxide - A compound of carbon and oxygen formed when carbon or carbon materials are burned or used in the body.

Carbon Monoxide - A compound of carbon and oxygen formed when carbon or carbon materials are incompletely burned. When formed in automobiles, it becomes a major air pollutant.

Catalytic Converter - A device placed on the exhaust of an automobile that changes carbon monoxide and hydrocarbons, which cause air pollution, to carbon dioxide and water.

Centigrade - See Celsius.

Celsius - A temperature scale which runs from zero degrees (the temperature of melting ice) to one hundred degrees (the temperature of boiling water). Sometimes called centigrade.

Charcoal - A porous, solid residue resulting from the incomplete combustion of wood or bone.

Chemical Energy - Energy stored in the structure of atoms and molecules, which can be released by a chemical reaction.

Clean Fuel - A low sulfur fuel.

Coal - A solid organic material formed by the decomposition of plant material without air, containing 75% carbon.

Coal Gas - "Fuel gas", the gas formed when coal is partially burned to make coke. Has 1/3 the energy of natural gas.

Coal Gasification - The process which converts coal to a gas.

Coal Liquification - The process which converts coal to a liquid fuel by the addition of hydrogen.

Coal Tar - A black, gummy substance produced when coal is distilled.

Coke - A porous, solid residue resulting from the incomplete combustion of coal heated in an oven with a limited supply of air. A good fuel, more nearly pure carbon than coal.

Combustion - Burning, a chemical reaction producing heat and light and, in some cases, a flame. Usually a combination of carbon and oxygen.

Conduction - The transmission of energy directly from one substance or molecule to another.

Conserve - To keep from being lost, wasted, or damaged.

Convection - The transfer of energy by moving masses of liquid or gases.

Conversion - The process by which energy is changed from one form to another.

Cooling Tower - A structure for cooling waste water from power plants.

Cord - A measure of wood volume - a stack four feet by four feet by eight feet.

Cracking - The process of breaking down the molecular structure of heavy hydrocarbons into lighter hydrocarbons, as when gasoline is produced from crude oil.

Crude Oil - A mixture of hydrocarbons in liquid form found in underground reservoirs; the raw material from which most refined petroleum products are made.

Depletion Allowance - A tax exemption for a portion of the revenue received from depleting a natural energy resource (e.g., removing oil from a well).

Dry Steam - Steam so hot it contains no water droplets.

Ecology - The study of relationships between living things and their environment.

Efficiency - The ratio of the work or energy output to the energy input to do the work.

Electric current - A flow of charged particles, usually electrons.

Electrons - Negatively charged particles that orbit the nucleus of an atom. A chemical reaction consists of the transfer and rearrangement of electrons between atoms.

Electrostatic Precipitator - A device that removes waste particles from the exhaust of power plants by attracting them to electrically charged plates from which they can be washed away, thus preventing air pollution.

Energy - The ability to do work; to move a force a certain distance. It exists in many forms and can be converted from one form to another.

Energy Density - The energy per unit of weight in a fuel.

Energy Intensiveness - A measure of energy utilitization. For example, the number of calories used to move a passenger one mile.

Environment - Everything that is not you - and you.

Environmental Impact Statement - A predicted analysis of the impact on the environment of a projected activity. For example, the mining of coal, or offshore drilling for oil.

Fahrenheit - A temperature scale which uses 32 degrees as the melting point of ice and 212 degrees as the boiling point of water, named after its inventor.

First Law of Thermodynamics - The law of conservation of energy, which states that energy can neither be created nor destroyed.

Fission - The splitting of atoms (heavy nuclei) to release energy.

Food - The fuel used by animals, including man, to produce "body power".

Food Chain - The pathway over which any food material passes from the producing organism to consuming organisms.

Force - The power exerted on an object to produce motion or change of direction.

Fossil Fuel - A natural fuel such as coal, oil, or natural gas, formed from the fossil remains of living things.

Fuel - A substance that can be burned to produce heat.

Fusion - The joining together of atoms to release energy.

Gasoline - A fuel composed primarily of light hydrocarbons, produced by "cracking" crude oil in a refinery.

Generator - A device which produces electric energy from mechanical energy, as in a motor or water turbine.

Geothermal Energy - Heat energy within the earth which produces steam when it comes in contact with water.

Geyser - A spring from which hot water and steam shoot into the air.

Greenhouse Effect - The warming effect of the carbon dioxide in the atmosphere which allows solar radiation to reach the earth but which absorbs (and keeps in) the heat radiation from the earth.

Harness - To control so as to use the power of, as of steam.

Heat - A form of kinetic energy resulting from the movement of molecules in matter. It flows from one body to another if there is a temperature difference between them.

Heat Engine - A device which converts heat energy into mechanical energy.

Heat Pump - A device which transfers heat from one place to another by using electric or mechanical energy. It can pump warm air into a building to heat it, or out of a building to cool it.

Heat Sink - Any substance that absorbs waste heat - air, water, or space.

Heat Tax - The heat energy that is lost when energy is converted from one form to another.

Horsepower - A unit of power equal to 746 watts.

Hydrocarbons - Molecules made up of hydrogen and carbon atoms in various proportions, usually formed by living things.

Hydroelectric Plant - An electric power plant in which electricity is generated by using the energy of falling water to turn turbines.

Indirect Energy - Any form of energy used to provide goods and services, which themselves may or may not use energy.

Joule - A unit of energy or work; the amount produced by a force of one newton operating through the distance of one meter, named after its inventor.

Kerosene - A fuel used in jet engines and gas turbines, made up of a mixture of hydrocarbons by "cracking" crude oil in a refinery. Its hydrocarbons are heavier than those in gasoline or naphtha.

Kilowatt - A unit of electric power equal to 1000 watts.

Kilowatt-hour - A unit of energy or work equal to the use of one kilowatt of energy for one hour.

Kinetic Energy - The energy of motion; the ability of an object to do work because of its motion.

Laser - A device which can produce high intensity radiation by forcing the atoms or molecules in a material to radiate at the same time, rather than independently, as in a light bulb.

Light - Electromagnetic radiation which can affect the eye.

Light Water Reactor - A nuclear reactor in which water is the primary coolant or moderator.

Liquified Natural Gas (LNG) - Natural gas that has been turned to a liquid by cooling it to minus 160 degrees Celsius, thus reducing its volume and making it easier and cheaper, and probably more dangerous, to store and ship.

Machine - A device which uses energy to do work.

Mechanical Energy - A form of energy which is seen as the motion of an object.

Megawatt - A unit of power equal to 1000 kilowatts or one million watts.

Moderator - The material (water, graphite, etc.) used in a nuclear reactor to control the rate of fission.

Natural Gas - A natural mixture of hydrocarbons found in porous rocks under the earth's surface, usually in association with petroleum. It is almost pure methane.

Non-renewable - Not able to be replaced once used up, as oil.

Nuclear Energy - Atomic energy, the energy released by changes in the nucleus of an atom in a reactor.

Nucleus - The dense, positively charged core of an atom.

Off-peak Power - Power generated during a period of low demand.

Oil Shale - A sedimentary rock containing the material kerogen, which can be recovered as oil when the rock is heated at high temperatures.

Particulates - Small ash and soot particles produced in burning.

Peak Load - The maximum amount of power which a plant can produce in a given period of time.

Petrochemicals - Chemicals derived from petroleum.

Petroleum - An oily, flammable liquid mixture of hydrocarbons that may vary from almost colorless to black, found in sedimentary rocks, and providing the raw material for a host of fuels and synthetic materials.

Photosynthesis - The process by which green plants convert the radiant energy of the sun into chemical potential energy when carbon dioxide and water are converted into carbohydrates.

Photovoltaic Process - The process by which radiant energy is converted directly into electric energy.

Pollution - Contamination or fouling of land, air, or water, by chemicals, heat, noise, atomic radiation, or wastes.

Potential Energy - Stored energy, as in a battery or water behind a dam.

Power - The rate at which energy is used or work is done, measured in units of energy per unit of time (calories per second) or in units such as kilowatts or horsepower.

Primary Energy - Energy in its natural form, such as coal or oil, before its conversion to end-use forms of energy, such as heat or electricity.

Radiation - The emission of energy through matter or space.

Reserves - Portions of a resource, such as oil, which have been discovered and can be extracted by available technology.

Resource - A product of nature which people use to satisfy their needs, wants, and dreams.

Second Law of Thermodynamics - In any energy conversion, some energy passed from a useful to a less useful form, usually lost heat, or "heat tax."

Smog - An atmospheric condition in which the air is polluted by smoke, fog, sulphur and nitrous oxides. Sulphur oxides react with water to form sulphuric acid droplets, which fall as "acid rain," causing great damage to marble and limestone buildings and statues, and to bodies of water which become too acidic to support living things.

Solar Cell - A device which converts solar radiant energy directly into electric energy by the photovoltaic process.

Solar Collector - A device for collecting solar energy and converting it into heat.

Solar Energy - The electromagnetic radiation transmitted by the sun. The earth receives about 4000 trillion kilowatt-hours per day.

Synthetic Natural Gas (SNG) - A gaseous fuel manufactured from coal, containing almost pure methane.

Tar Sand - A sandy geologic deposit in which oil is found.

Temperature - The "hotness" or "coldness" of a substance.

Thermal Pollution - Any increase in air or water temperature by waste heat from electric generating plants, which causes disturbances in the ecological system of an area.

Turbine - A motor turned by a powerful stream of water or gas.

Uranium - A radioactive, metallic element used as a fuel in nuclear power plant reactors to generate electricity.

Utility - A company or organization which provides services for people, such as gas, oil, or electricity.

Volt - The electromotive force which will cause a current of one ampere to flow through a resistance of one ohm.

Watt - A metric unit of power used in electric measurements of the rate at which work is done or energy used. One watt equals one Joule of work per second.

Work - The product of a force multiplied by the distance the force is applied or the object is moved.

REFERENCES

Baird, Thomas, Pasco County Energy Management Center Education Materials, Port Richey, Fla.

Benry, Ronald M. and Robert F. Schultz. Alternative Energy Sources - Experiements You Can Do ... from Edison. Thomas Alva Edison Foundation. Cambridge Office Plaza, Suite 143, 18280 West Ten Mile Road, Southfield, Michigan 48085, 1978.

Citizens' Advisory Committee on Environment Quality, Citizen Action Guide To Energy Conservation, 1700 Pennsylvania Avenue, Northwest, Washington, DC 20006.

Clark, Wilson, Energy For Survival, (paper) Anchor Press, New York, N.Y., 1975.

Daniels, Farrington, Direct Use Of The Sun's Energy, Ballantine Books, New York, N.Y., 1975.

Florida Department of Education, Computations About the Sources and Conservation of Energy, Tallahassee, Florida.

Fowler, John, Energy-Environment Source Book, National Science Teachers Association, 1979.

Halacy, D.S., The Coming Age of Solar Energy, Avon, N.Y., 1973.

Knox, Susan, The Energy Crisis Survival Kit, Manor Books, New York, N.Y., 1974.

Lefkowitz, R.J., Fuel For Today and Tomorrow, Parents Magazine Enterprises, New York, N.Y., 1974.

Lovins, Amory B., Soft Energy Paths: Toward A Durable Peace, Harper and Row, New York, N.Y., 1977.

Meadows, D., et al., The Limits To Growth, Universe Press, New York, N.Y., 1972.

Meinel, Aden and Marjorie, Power for the People, private publication, 1970.

Mother Earth News, Handbook of Homemade Power, Bantam, New York, N.Y., 1974.

Schmacher, E. F., Small Is Beautiful, Harper and Row, New York, N.Y., 1973.

Schultz, Robert F., Environmental Experiments...from Edison. Thomas Alva Edison Foundation, Cambridge Office Plaza, Suite 141, 18280 West Ten Mile Road, Southfield, Michigan 48075, 1979.

Singh, Ram Bux, Biogas Plan, Mother Earth News, Post Office Box 70, Hendersonville, North Carolina 28739.

Stoner, Carol, Editor, Producing Your Own Power, Vintage, New York, N.Y., 1974.

Thoreau, Henry David, Walden, Pauper Press, Two Rivers, Wisconsin, 1966.

U. S. Department of Energy, Energy Conservation As A Political Issue, Washington, D.C., 1982.

U. S. Department of Energy, Energy in Less Developed Countries, Washington, D.C., 1982.

U. S. Department of Energy, Energy in the Global Marketplace, Washington, D.C., 1978.

U. S. Department of Energy, Energy For The Future?, Washington, D.C., 1982.

U. S. Department of Energy, The Energy Future Today, Washington, D.C., 1980.

U. S. Department of Energy, The Exponential Energy Century, Washington, D.C., 1982.

U. S. Department of Energy, Solar Energy: Science Activities in Energy, Washington, D.C., 1979.

U. S. Department of Energy, Transportation and the City, Washington, D.C., 1979.

U. S. Environmental Protection Agency, 1977 Gas Mileage Guide for New Car Buyers, (Second Edition) Pueblo, Colorado, January 1977.

Wilson, Michael, and the Editors, Energy, Time-Life Books, Life Science Library, New York, N.Y., 1970.

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AND

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Arlington, Virginia 22209
(703) 524-2000

Florida Solar Energy Center
300 State Road 401
Cape Canaveral, FL 32920
(305) 783-0300

National Coal Association
1130 - 17th Street, N.W.
Washington, D.C. 20036
(202) 628-4322

U.S. Department of Energy
Technical Information Center
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Oak Ridge, Tennessee 37830
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National Energy Information Center
12th & Pennsylvania Avenue, N.W.
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Local Utility Companies

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Local, state and national environmental organizations

REVIEW SHEET (11-12)

This teachers' guide, Energy and My Environment (11-12), is for your review, field testing and comments. Your evaluation of these lessons will be sincerely appreciated and your suggestions considered for inclusion in a revised publication.

Sections of Guide Taught

Grade ___ Unit ___ Lesson ___ Grade ___ Unit ___ Lesson ___

Grade ___ Unit ___ Lesson ___ Grade ___ Unit ___ Lesson ___

Grade ___ Unit ___ Lesson ___ Grade ___ Unit ___ Lesson ___

Are lessons appropriate for grade level? _____

_____

Describe reaction of students. _____

_____

Is there sufficient emphasis on teaching energy facts? _____

_____

Is there sufficient emphasis on teaching values? _____

_____

Your ideas for extending the lessons:

Grade ___ Unit ___ Lesson ___ _____

_____

Grade ___ Unit ___ Lesson ___ _____

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Grade ___ Unit ___ Lesson ___ _____

_____

Please put additional ideas on back of review sheet; include the grade, unit and lesson numbers.

Other comments and suggestions: _____

_____

_____

Reviewer: _____

Title: _____

School _____ County _____

Address: _____

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